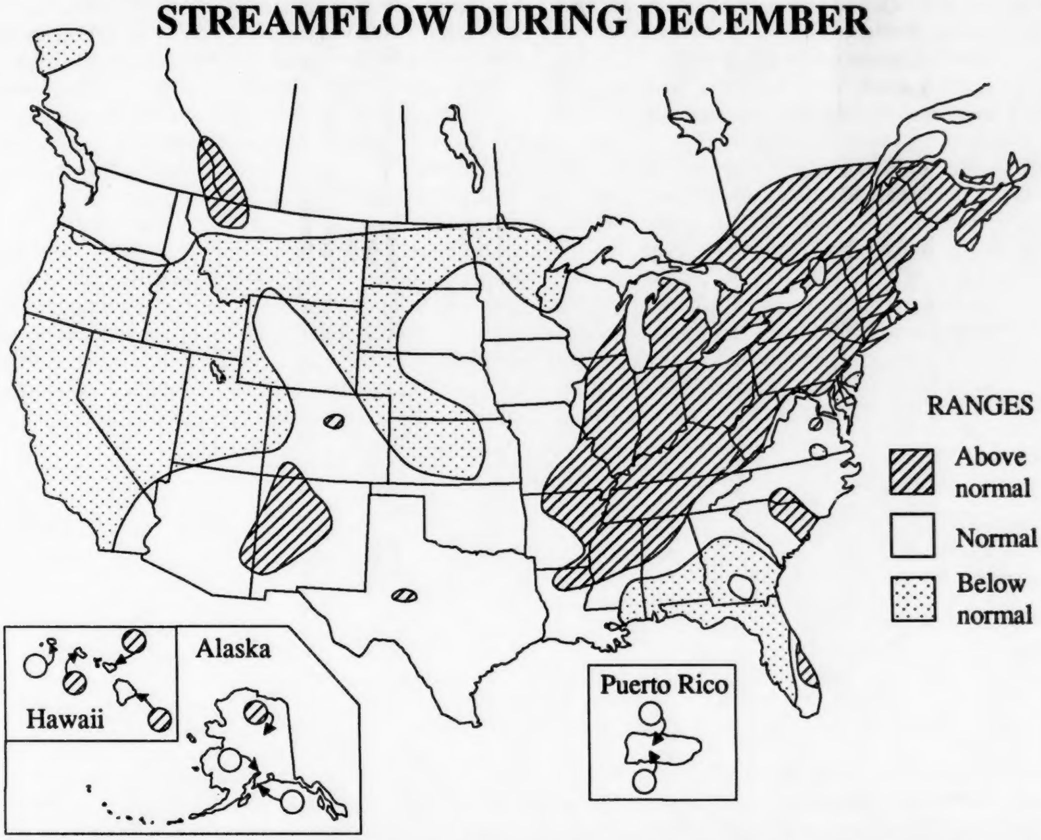
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

DECEMBER 1990

STREAMFLOW DURING DECEMBER



Heavy rains during the last week of December, combined with melting snow in northern areas, caused floods in an area stretching from from Alabama to Pennsylvania. The worst floods occurred in Alabama, Ohio, and Tennessee, where peak discharges at several stations exceeded those of record or the 100-year flood, and also in Indiana.

However, in most of California and part of Florida, there was continuing drought, despite some relief from monthend rains. Reservoir storage and rainfall were both below average in California, and 10 percent of more than 300 wells in southwest Florida were at all-time lows.

Streamflow was in the normal to above-normal range at 76 percent of the index stations in the United States, southern Canada, and Puerto Rico during December. Below-normal range streamflow occurred in 27 percent of the area of the conterminous United States and southern Canada during the month.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged 16 percent above median and in the normal range during the month.

Monthend index reservoir contents were in the below-average range at 35 of 100 reporting sites.

Mean December elevations at the four master gages on the Great Lakes were in the below-normal range on Lake Superior and in the normal range on Lake Huron, Lake Erie, and Lake Ontario.

Utah's Great Salt Lake remained at 4,202.40 feet above National Geodetic Vertical Datum of 1929 for the second consecutive month.

SURFACE-WATER CONDITIONS DURING DECEMBER 1990

Heavy rains during the last week of December, combined with melting snow in northern areas caused floods in an area stretching from from Alabama to Pennsylvania. The most severe floods occurred in Alabama, Ohio, and Tennessee, where peak discharges at several stations exceeded those of record or the 100-year flood. Peaks in Indiana exceeded that of record at one station and equalled the 50-year flood at another. Details on the floods, including maps and tables are presented on pages 4-5.

However, in most of California and part of Florida, there was continuing drought, despite some relief from monthend rains. Excerpts from the *California Water Supply Outlook* of December 27 on page 7 portray conditions in that State. Much of Florida continues to have record or near-record low streamflow, lake, and ground-water levels. (See pages 6,8, and 20-21.)

Streamflow was in the normal to above-normal range at 76 percent of the index stations in the United States, southern Canada, and Puerto Rico during December, compared with 80 percent of stations in those ranges during November, and 53 percent of stations in those ranges during December 1989. Below-normal range streamflow occurred in 27 percent of the area of the conterminous United States and southern Canada during December 1990, compared with 23 percent during November and 29 percent during December 1989. Total December 1990 flow of 767,800 cfs for the 174 index stations in the conterminous United States and southern Canada was 34 percent above median, 38 percent greater than last month, and 64 percent greater than flow during December 1989.

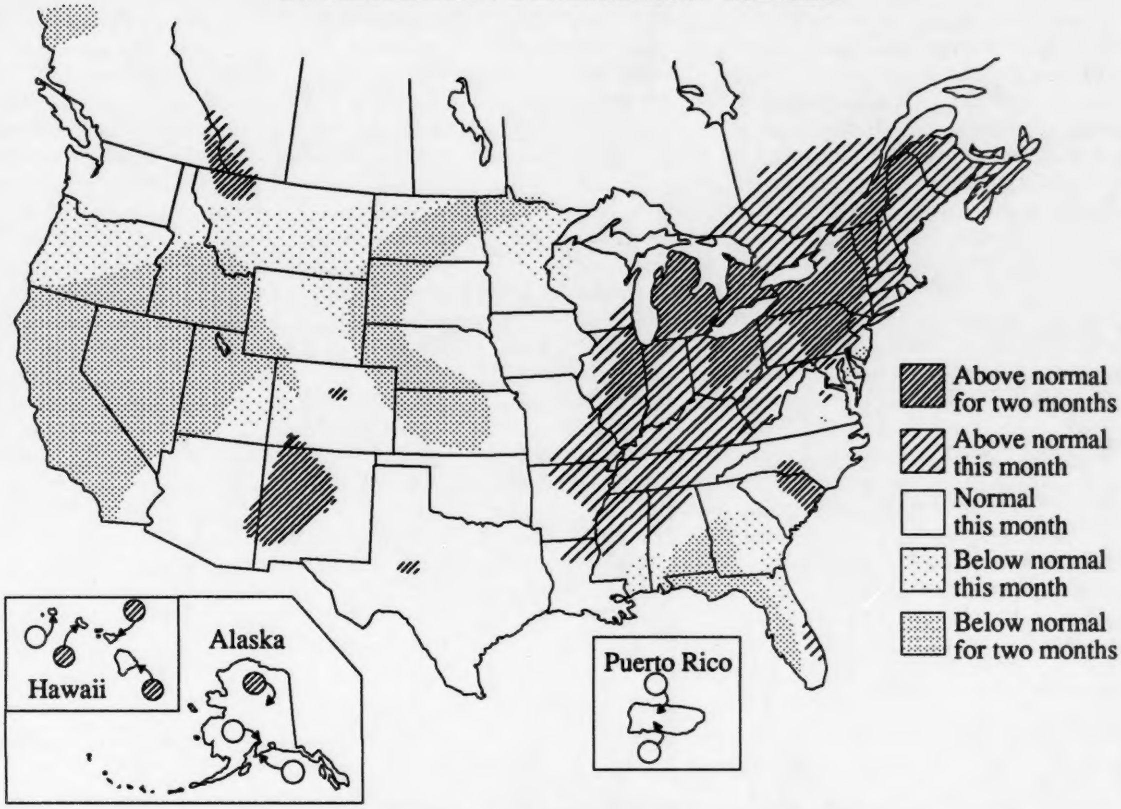
Fourteen new extremes (table on page 6), six lows and eight highs, occurred at streamflow index stations during December, compared with two lows and four highs during November. Hydrographs for those stations where new extremes occurred are on pages 8-9. Only the lower part of the hydrograph for Arroyo Seco near Pasadena, California, is shown, while both the entire hydrograph and and an expanded view of the lower part of the hydrograph for Fisheating Creek at Palmdale, Florida are shown.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged 969,700 cfs (16 percent above median and in the normal range) during December, 27 percent more than during November. Flow of the St. Lawrence River was in the normal range for the tenth consecutive month. Flow of the Mississippi River was in the normal range for the third consecutive month (after five consecutive months in the above-normal range), and flow of the Columbia River was in the normal range after an above-normal range November, normal range October, and a below-normal September. Hydrographs for both the combined and individual flows of the "Big 3" are on page 8. Dissolved solids and water temperatures

(Continued on page 6)

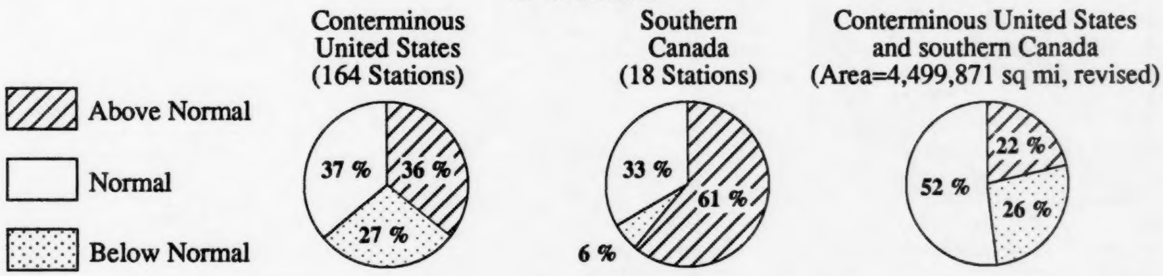
CONTENTS

DECEMBER 1990 STREAMFLOW RANGES

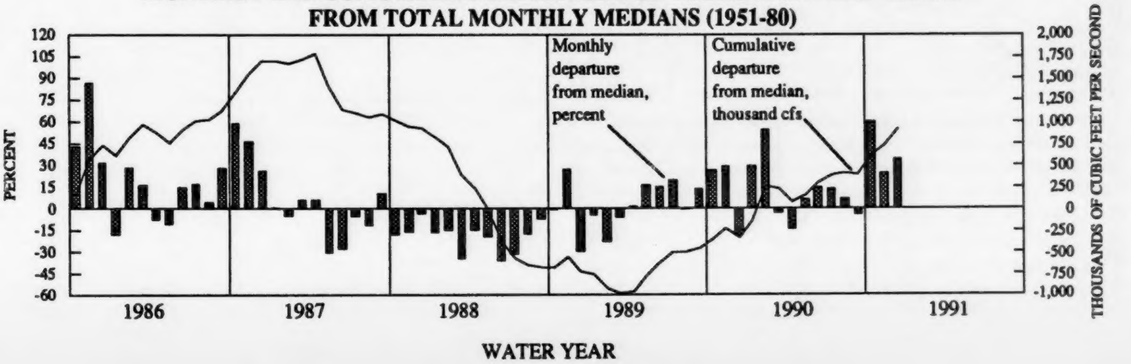


SUMMARY OF DECEMBER 1990 STREAMFLOW

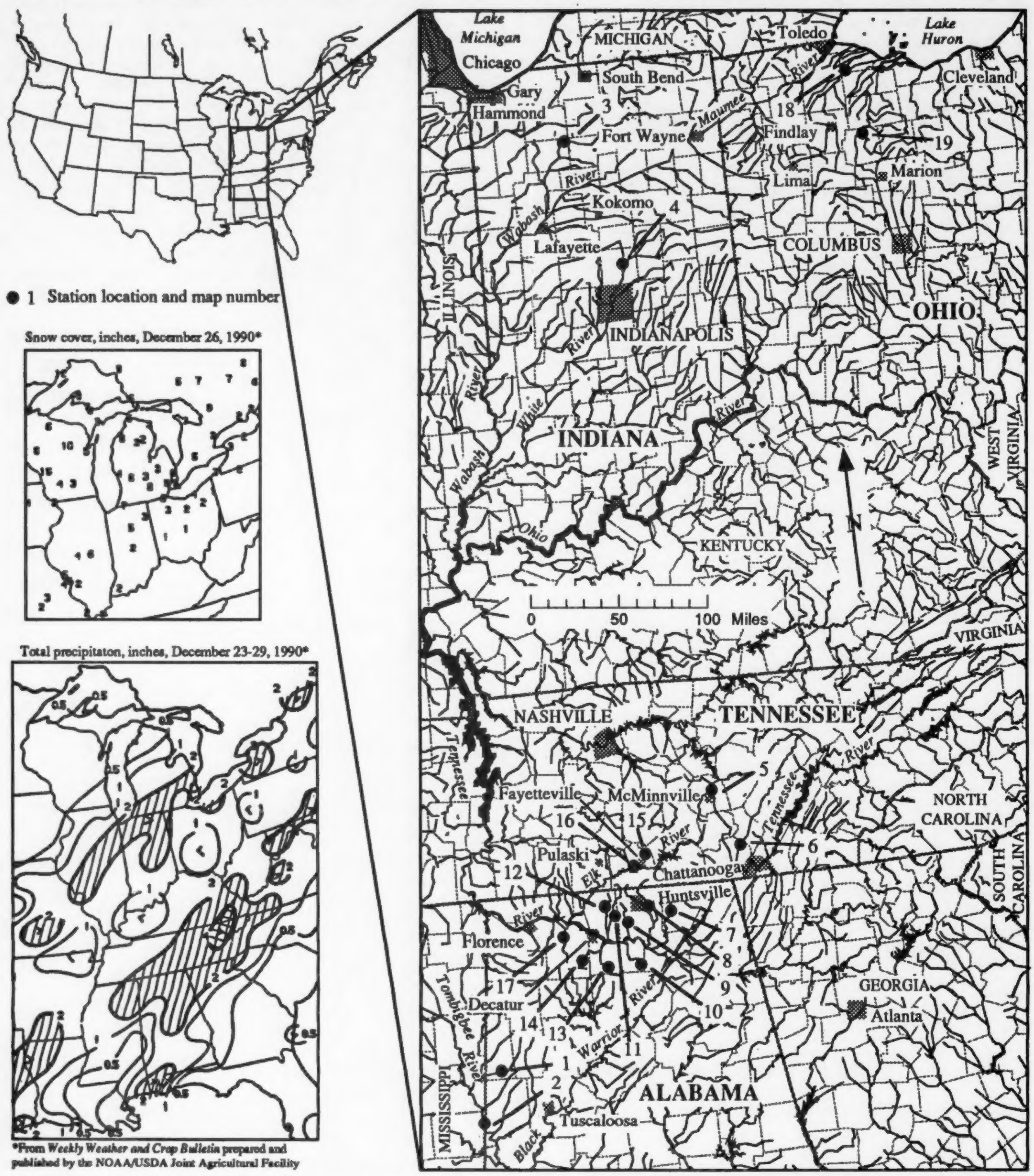
FLOW RANGES



MONTHLY AND CUMULATIVE DEPARTURE OF TOTAL MONTHLY MEANS FROM TOTAL MONTHLY MEDIANS (1951-80)



FLOODS OF DECEMBER 1990-JANUARY 1991 IN ALABAMA, INDIANA, TENNESSEE, AND OHIO



*From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility

In Alabama, flooding in the northern and western parts of that State was caused by several days of steady rain falling on saturated soil. The maximum stage on the Tombigbee River at Beville Lock and Dam near Pickensville feet was 2.10 feet above the previous peak. However, discharge for the current peak is being determined by indirect methods and is not yet available. Peak discharges equalled or exceeded those for the 100-year flood at five stations in the vicinity of Huntsville: Paint Rock River near Woodville, Flint River near Chase, Cotaco Creek near Athens, Flint Creek near Falkville, and Big Nance Creek at Courtland. Peaks of record also occurred at streamflow stations on Luxapallila Creek at Millport, in the Mobile River basin, about 50 miles west of Birmingham, and West Fork Flint Creek near Oakville, in the Tennessee River basin about 35 miles southwest of Huntsville.

Widespread flooding occurred in Indiana when 3-6 inches of rain fell December 28-30, 1990, melting snow cover varying from 2-9 inches. Recurrence intervals for peak discharges in the State varied from 10 to 50 years. The only peak discharge of record occurred on the White River at Noblesville, but the recurrence interval was only 40 years. However, on

January 1, 1991, stage on the Tippecanoe River near Ora peaked only 0.12 feet below the previous maximum. Larger streams, such as the Wabash, Kankakee, and White Rivers caused some flooding in low-lying areas. Between 3,000 and 4,000 people were displaced by flooding according to the Indianapolis Star. Noblesville, Indianapolis, Columbus, and Terre Haute were the cities most severely affected. The State asked the Federal government to declare 40 of Indiana's 92 counties disaster areas. According to the Indiana State Emergency Management Agency, this was the worst flooding in 40 years.

In Tennessee, flooding in the eastern part of the State December 23-25 was caused by two days of steady rain falling on saturated soil. Peaks of record or the 100-year flood were exceeded at four stations in the south-central part of the State.

In Ohio, warm temperatures December 28-29,1990, melting about 3 inches of snow in the northern third of the State, were followed by 2.5-3 inches of rain across the entire State. Small stream and urban flooding led to evacuation of parts of Cleveland and Columbus on December 30, 1990. Larger streams peaked later, causing flooding in several small towns December 31, 1990-January 1, 1991. The most severe floods occurred in the northern part of the State, where large streams such as the Cuyahoga and Maumee Rivers peaked at discharges with recurrence intervals of about 25 years. However, the Portage River at Woodville peaked at the 100-year flood discharge on December 31, but at less than the flood of record. The peak discharge of Tymochtee Creek at Crawford exceeded the previous record, but had a recurrence interval of less than 50 years. Peak discharges of streams in the rest of Ohio had recurrence intervals of less than 10 years.

Provisional data; subject to revision

FLOOD DATA FOR SELECTED SITES IN ALABAMA, INDIANA, TENNESSEE, AND OHIO DECEMBER 1990-JANUARY 1991

					Maximum flood previously known			Maximum during present flood				
								Discharge				Recurrence
Map number	WRD Station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Cfs	Cfs per square mile	interval (years)
		ALABAMA										
		MOBILE RIVER BASIN										
1	02442500	Luxapallila Creek at Millport	247	1954-59	Dec. 3, 1983	13.74	13,300	Dec. 24	14.07	15,500	62.78	50
				1980-								
2	02444160	Tombigbee River at Bevill Lock and Dam, near Pickensville	5,750	1980-	May 23, 1983	41.95	130,000	26	44.05	(1)	(1)	(1)
		INDIANA										
		WABASH RIVER BASIN										
3	03331500	Tippecanoe River near Ora	856	1943-	June 15, 1981	15.08	8,660	Jan. 1	15.10	[2]7,000	8.17	50
					Aug. 20, 1990	15.22	8,470					
4	03349000	White River at Noblesville	858	1946-	Apr. 22, 1964	21.31	26,800	Dec. 31	21.29	27,000	31.5	40
		TENNESSEE										
		CUMBERLAND RIVER BASIN										
5	03421000	Collins River near McMinnville	640	1925-	Mar. 23, 1929	[3]39.1	75,300	23	38.70	74,300	116	60
		TENNESSEE RIVER BASIN										
6	03571000	Sequatchie River near Whitwell	402	1921-	Mar. 16, 1973	17.65	32,500	23	17.93	34,700	86.3	[4]1.07
		ALABAMA										
7	03574500	Paint Rock River near Woodville	320	1935-	Mar. 16, 1973	24.40	74,200	23	23.42	56,900	178	[4]1.1
8	03575000	Flint River near Chase	342	1929-	Mar. 16, 1973	29.52	104,000	23	31.04	87,300	255	[4]1.2
9	03575830	Indian Creek near Madison	49.0	1959-	Mar. 16, 1973	12.70	16,500	22	11.76	11,600	237	50
10	03576148	Cotaco River near Athens	136	1963-81	Mar. 16, 1973	16.36	11,700	23	19.50	23,300	171	100
				1990-								
11	03576250	Limestone Creek near Athens	119	1940-81	Mar. 16, 1973	17.28	45,800	23	15.20	26,700	224	50
				1990-								
12	03576400	Piney Creek near Athens	55.8	1951-70	Mar. 12, 1963	13.38	12,900	22	10.80	9,500	170	50
				1990-								
13	03576500	Flint Creek near Falkville	86.3	1953-73	Mar. 16, 1973	15.85	12,500	23	19.68	31,600	366	[4]2.0
				1990-								
14	03577000	West Flint Creek near Oakville	87.6	1953-69	Mar. 16, 1973	26.94	7,200	23	28.00	7,900	90.2	25
				1990-								
		TENNESSEE										
15	03580995	East Fork Mulberry Creek at Lynchburg	23.4	1988-	Feb. 21, 1989	7.95	2,520	23	10.01	5,000	214	14
16	03582000	Elk River above Fayetteville	827	1935-	Mar. 16, 1973	28.63	41,600	23	29.52	45,000	54.4	(5)
17	03586500	Big Nance Creek at Courtland	166	1935-	Mar. 16, 1973	24.97	27,200	23	24.21	21,900	132	[4]1.3
		OHIO										
18	04195500	Portage River at Woodville	428	1913, 1928	Feb. 15, 1950	14.51	11,500	31	13.67	14,000	32.7	100
				1935, 1939-	Mar. 1913	[6]17.00	[2]17,000					
19	04196800	Tymochtee Creek at Crawford	229	1961-	Mar. 17, 1978	9.94	6,390	31	9.77	6,700	29.3	(8)
					Mar. 6, 1963	[7]11.21	(1)					

[1] Not determined.
[2] Estimated.
[3] Flood in 1854 is believed to have been about equal to that of March 23, 1929, from information by local residents.
[4] Recurrence interval greater than 100 years. Value shown is approximate ratio of discharge to that of 100-year flood.
[5] Not determined, regulated.
[6] From information gathered by local residents.
[7] Backwater from ice.
[8] Recurrence interval less than 50 years, but not determined.

NEW EXTREMES DURING DECEMBER 1990 AT STREAMFLOW INDEX STATIONS

Station number	Stream and place of determination	Drainage area (square miles)	Previous December extremes (period of record) Years of record	Monthly mean in cfs (year)	Daily mean in cfs (year)	December 1990 Monthly mean in cfs	Percent of median	Daily mean in cfs	Day
	LOW FLOWS								
02256500	Fisheating Creek at Palmdale, Florida	311	59	.33 (1961)	0 (1955)	.27	1	.16	25
02320500	Suwannee River at Branford, Florida	7,880	59	1,631 (1943)	1,580 (1955)	1,599	49	1,550	1
06867000	Saline River near Russell, Kansas	1,502	39	3.06 (1983)	0.21 (1983)	1.43	5	.94	1
09304500	White River near Meeker, Colorado	755	77	233 (1977)	190 (1966)	220	68	205	24
10296000	West Walker River below Little Walker River, near Coleville, California	181	52	23.1 (1948)	18.0 (1948)	21.3	41	20.0	*
11098000	Arroyo Seco near Pasadena, California	16	79	.14 (1929)	.10 (1933)	.02	1	.01	*
	HIGH FLOWS								
01980100	St. Mary's River at Stillwater, Nova Scotia, Canada	523	75	4,273 (1975)	19,915 (1975)	5,296	227	23,481	10
01980300	Northeast Margaree River at Margaree Valley, Nova Scotia	142	73	1,420 (1969)	7,630 (1975)	1,712	235	9,887	9
03109500	Little Beaver Creek near East Liverpool, Ohio	496	75	1,955 (1927)	13,700 (1942)	2,015	433	8,220	31
03234500	Scioto River at Higby, Ohio	5,131	60	13,540 (1950)	52,300 (1942)	17,244	425	38,200	31
03253500	Licking River (adjusted) at Catawba, Kentucky	3,300	64	18,500 (1978)	60,200 (1978)	24,200	529	52,300	21
03326500	Mississinewa River at Marion, Indiana	682	67	2,416 (1923)	16,210 (1924)	2,953	606	20,500	31
03540500	Emory River at Oakdale, Tennessee	764	63	6,201 (1942)	86,000 (1969)	7,938	345	103,000	23
03574500	Paint Rock River near Woodville, Alabama	320	55	3,323 (1967)	25,700 (1969)	3,650	466	47,400	23

*Occurred more than once.

at five large river stations are also given on page 10. Flow data for the "Big 3" and 42 other large rivers are given in the Flow of Large Rivers table on page 11.

Monthend index reservoir contents for December 1990 were in the below-average range (below the monthend average for the period of record by more than 5 percent of normal maximum contents) at 35 of 100 reporting sites, the same number as at the end November 1990, and 1 less than the 36 in that range at the end of December 1989, including most reservoirs in Nebraska, the Dakotas, Montana, Idaho, Wyoming, Colorado, Utah, Nevada, and California. Contents were in the above-average range at 46 reservoirs (compared with 40 last month), including most reservoirs in Nova Scotia, Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, Pennsylvania, Maryland, North Carolina, Georgia, Alabama, the Tennessee Valley, Texas, Oklahoma, and Wisconsin. Reservoirs with contents in the below-average range and significantly lower than last year (with normal maximum contents of at least 1,000,000 acre-feet) are: Lake Sidney Lanier, Georgia; Lake McConaughy, Nebraska; Boise River, Idaho; Upper Snake River, Idaho-Wyoming; Bear Lake, Idaho-Utah; Folsom, Clair Engle Lake, Lake Berryessa, and Shasta Lake, California; and also the Colorado River Storage Project. Reservoirs with less than 10 percent of normal maximum contents (December average in parentheses) are: John Martin, Colorado, 9 percent (18); Isabella, 8 percent (26), and Pine Flat, 4 percent (47), California; Lake Tahoe, California-Nevada, 0 percent (46); Rye Patch, Nevada, 0 percent (50); and San Carlos, Arizona, 5 percent (23). Graphs of contents for seven reservoirs are shown on page 12 with contents for the 100 reporting reservoirs given on page 13.

Mean December elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were in the below-normal range on Lake Superior and in the normal range on Lake Huron, Lake Erie, and Lake Ontario. Levels on all four lakes have been in the same ranges for seven months. Levels fell from those for November on both Lake Superior and Lake Huron, and rose from those for last month on the other lakes. December levels ranged from 0.19 foot lower (Lake Superior) to 0.07 foot higher (Lake Erie) lower than those for November. Monthly means have now been in the below-normal range for 15 months on Lake Superior. Monthly means have been in the normal range for 7 months on Lake Huron, for 33 months on Lake Erie and for 20 months on Lake Ontario. December 1990 levels ranged from 0.11 foot (Lake Superior) to 0.81 foot higher (Lake Erie) than those for December 1989. Stage hydrographs for the master gages on Lake Superior, Lake Huron, Lake Erie, and Lake Ontario are on page 14.

Utah's Great Salt Lake (graph on page 14) remained at 4,202.40 feet above National Geodetic Vertical Datum (NGVD) of 1929 during December as lake level remained steady for two months after

peaking at 4,204.70 feet above NGVD of 1929 in March-April. Lake level is 2.00 feet lower than at the end of December 1989, and 9.45 feet lower than the maximum of record which occurred in June 1986 and March-April 1987.

Streamflow conditions for December 1990 and December 1989 are shown by maps on page 15. December 1990 has about 13 percent less area in the below-normal range, 214 percent more area in the above-normal range , and about 17 percent less area in the normal range than December 1989. A contiguous area of British Columbia, Alberta, and Montana, and also part of the Carolinas have streamflow in the above-normal range during both months. Several areas in the West and Midwest have streamflow in the below-normal range during both months. The locations of reservoirs with below-average contents at the end of December 1990 and December 1989 are also shown on the respective maps.

Streamflow conditions for fall 1990 and fall 1989 are shown by maps on page 16. Fall 1990 has about 140 percent more area in the above-normal range, and about the same area in the below-normal range as fall 1989. Parts of the eastern United States and a small part of Montana have streamflow in the above-normal range for the fall of both years. Several areas in the West, Great Plains States, Louisiana, Georgia, and Florida have streamflow in the below-normal range during the fall of both years.

Streamflow conditions for the 1990 and 1989 calendar years are shown by maps on page 17. Calendar year 1990 has about 10 percent less area in the below-normal range, and 75 percent more area in the above-normal range than calendar year 1989. A few areas in the West, Midwest, Quebec, Georgia, and Florida have streamflow in the below-normal range for both years. A large area stretching from Texas to the southern parts of the central Great Lakes States, and a few small areas in the Northeast have streamflow in the above-normal range for both years.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged 1,173,000 cubic feet per second (17 percent above median and in the above-normal range) for calendar year 1990: 8 percent more than for calendar year 1989 (for which the average flow was in the normal range). Flow of the St. Lawrence River was 3 percent above median, but in the normal range for the second consecutive year. Flow of the Mississippi River was 29 percent above median, and in the above-normal range for the second consecutive year. Flow of the Columbia River was 6 percent below median and in the normal range after two consecutive years in the below-normal range.

Streamflow was in the normal to above-normal range at 79 percent of the index stations in the United States, southern Canada, and Puerto Rico for calendar year 1990.

Graphs for 12 hydrologic areas show monthly percent departure of streamflow from median for the 1986-90 water years (page 18) and also compare monthly streamflow for the 1990 and 1991 water years with median monthly streamflow for 1951-80 (page 19).

WATER-SUPPLY OUTLOOK IN CALIFORNIA

(From *California Water Supply Outlook* prepared and published by the California Department ofWater Resources)

The week before Christmas saw an extremely cold Arctic air outbreak over California. A snowstorm on the leading edge of the cold air brought snow to the mountains and accounted for about one-third of the current snow pack. Snow depths were enough to bring joy to the hearts of skiers, but the fluffy snow was "dry" with low water content. A scan of readings from the automatic snow sensors showed a snow pack water content almost one-fourth of average. This is comparable with the estimates of water year precipitation to date.

Assuming that the remaining 5 days of December are as dry as the season so far, with about 25 percent average moisture for the month, precipitation in the northern Sierra will be the 4th driest in 70 years. The water years with less precipitation were 1959-60, 76-77, and by a small margin, 1986-87. A review of the 11 driest October-December periods in this record did not show any predictive value. Precipitation during the three-month January through March quarter was above median amounts in about half the years and below in the other half. The current precipitation season is about one-third gone. With the large existing deficit, even normal rain and snow for the rest of the wet season is only expected to produce about half average runoff.

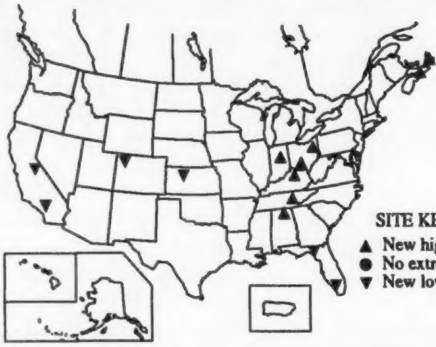
Reservoir storage on December 1 was 57 percent of average statewide. Normally storage gains slightly, about 3 percent during the month of December. This year, it appears that total storage may actually decrease very slightly during the month. As a result, the December 31 storage percentage may slip behind average a little bit more.

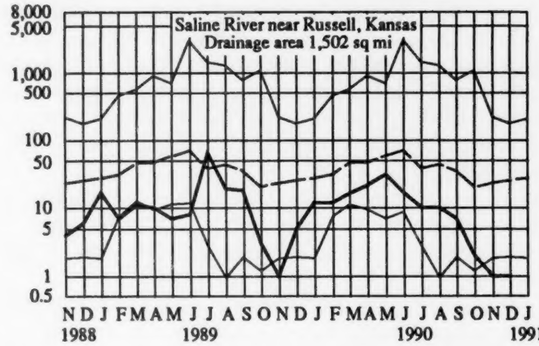
PRECIPITATION FOR OCTOBER 1-DECEMBER 26, 1990

Station	Inches	Percent of normal
Eureka	6.98	52
Shasta Dam	3.41	17
De Sabla	6.52	28
Blue Canyon	4.51	22
Sacramento	2.50	46
San Frandsco AP	2.25	36
Yosemite	4.02	33
Merced	1.15	31
Fresno	1.12	36
Glennville	2.14	41
Paso Robles	.31	8
Bakersfield	.54	34
Santa Barbara	.16	3
Los AngelesAP	.13	4
Blythe	0	0
San Diego	1.24	40

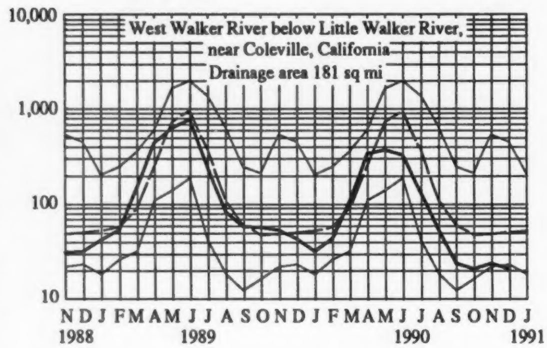
MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

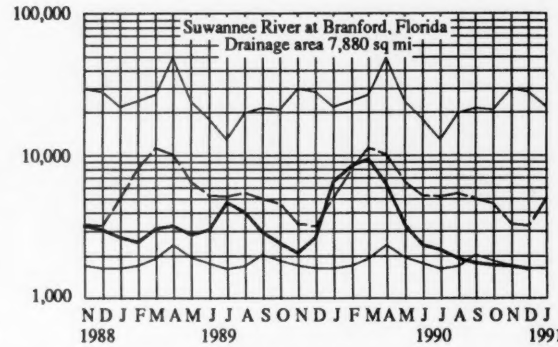
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.

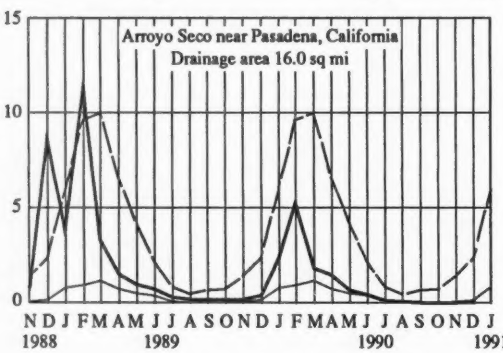


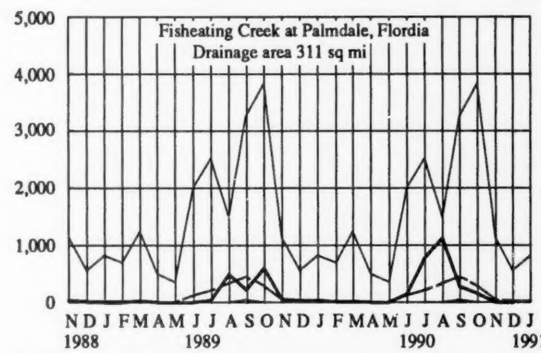


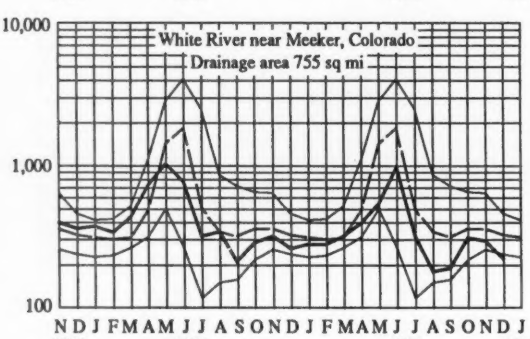
DISCHARGE IN CUBIC FEET PER SECOND

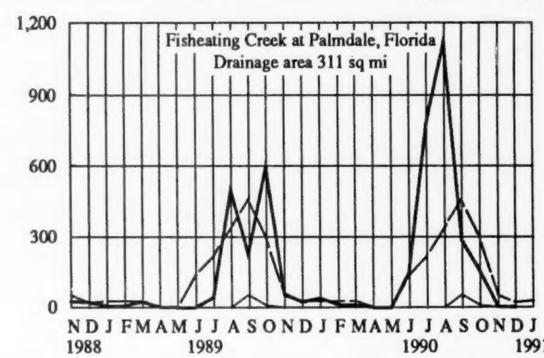








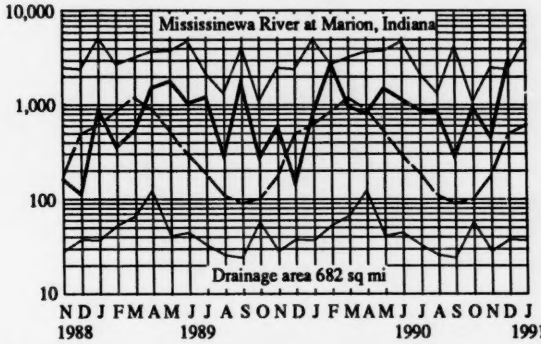


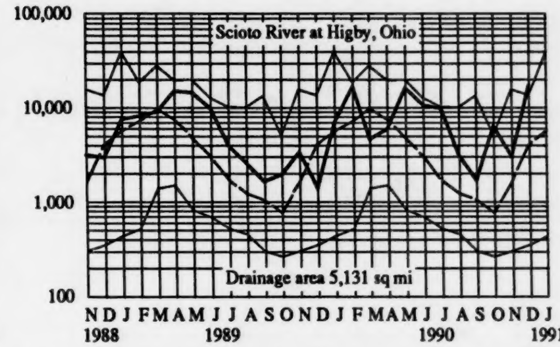


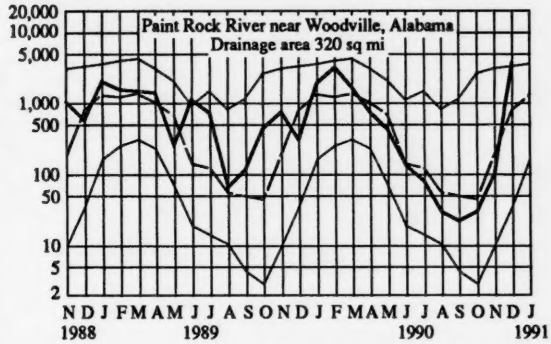
MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

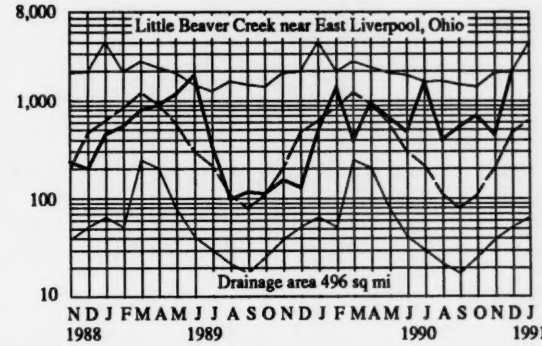
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.

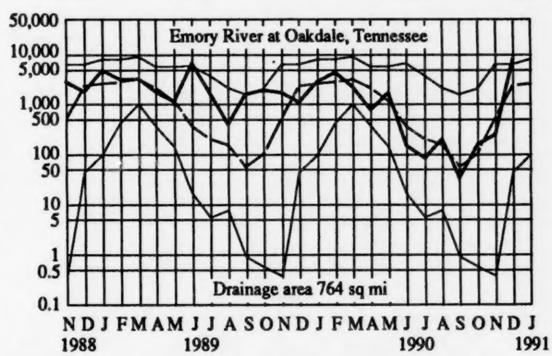
DISCHARGE IN CUBIC FEET PER SECOND

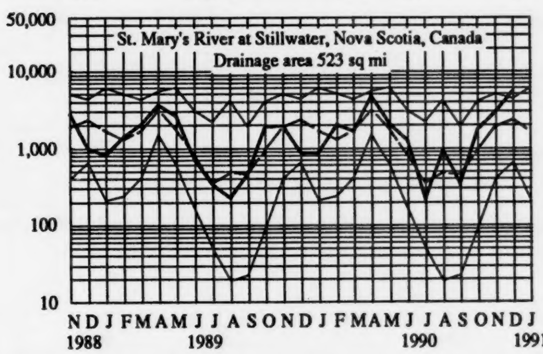


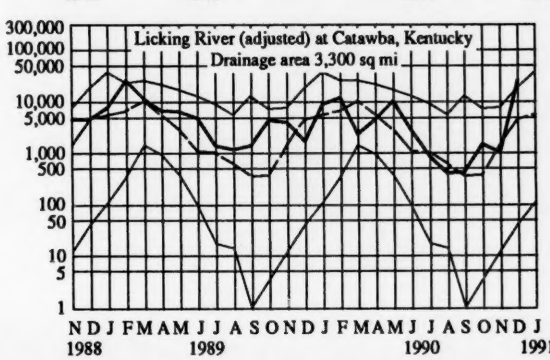


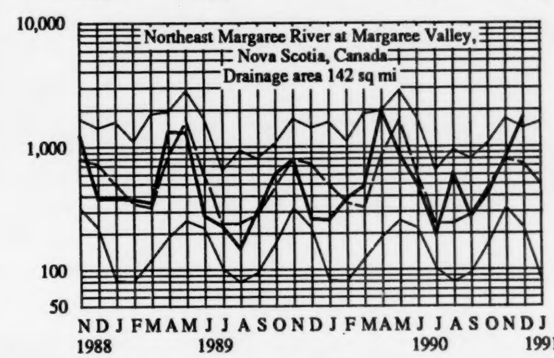






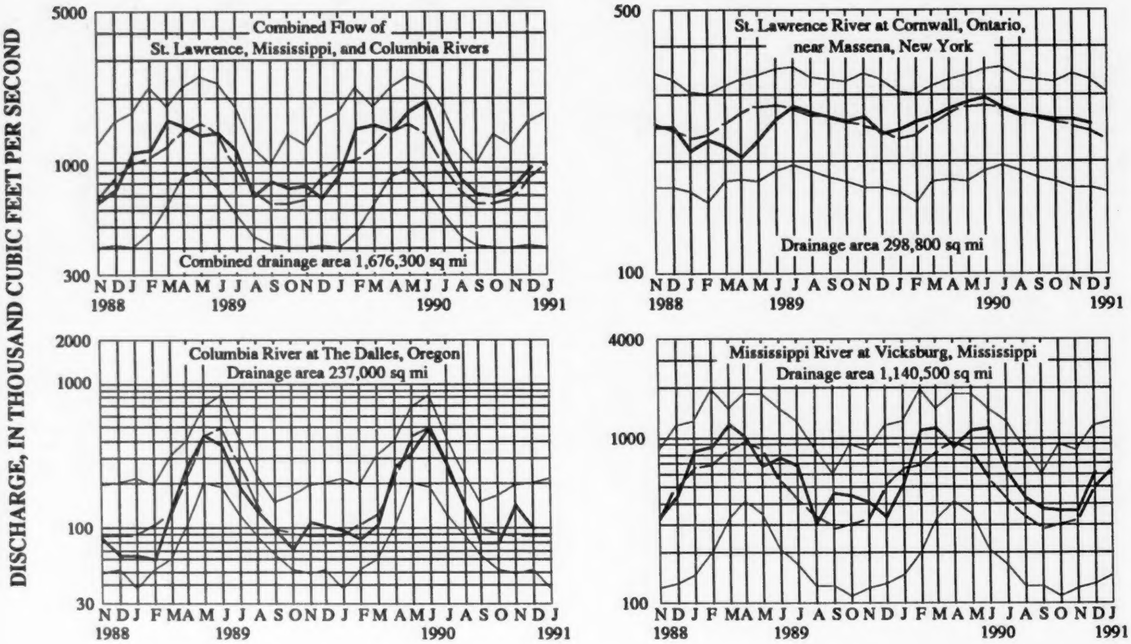






HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR DECEMBER 1990, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	December data of following calendar years	Stream discharge during month	Dissolved-solids concentration[1]		Dissolved-solids discharge[1]			Water temperature[2]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean (tons per day)	Minimum (tons per day)	Maximum (tons per day)	Mean in °C	Minimum in °C	Maximum in °C
01463500	Delaware River at Trenton,	1990	21,060	68	99	4,642	1,904	10,820	4.5	1.5	8.0
	New Jersey, (Morrisville,	1944-89	12,870	62	138	[3]3,727	463	13,440	[3]4.0	0	12.0
	Pennsylvania)	(Extreme yr)		(1983)	(1980)		(1963)	(1989)			
			[4]11,650								
07289000	Mississippi River at	1990	618,400	166	255	362,200	227,400	546,300	10.0	6.5	14.0
	Vicksburg, Mississippi	1975-89	710,600	153	343	402,000	130,500	712,800	7.5	0	13.0
		(Extreme yr)		(1978)	(1988)		(1988)	(1985)			
			[4]495,500								
03612500	Ohio River at lock and dam 53,	1990	551,000	165	245	......	47,100	344,000	...	4.0	14.0
	near Grand Chain, Illinois,	1954-89	322,200	138	362	......	21,300	469,000	...	0	14.0
	(streamflow station at Metropolis,	(Extreme yr)		(1962)	(1969)		(1980)	(1977)			
	Illinois)		[4]286,000								
06934500	Missouri River at Hermann,	1990	30,960	242	427	32,550	26,500	49,100	4.0	1.5	9.0
	Missouri. (60 miles west of	1975-89	74,130	222	770	73,640	18,000	237,000	3.5	0	14.0
	St. Louis, Missouri)	(Extreme yr)		(1982)	(1978)		(1989)	(1982)			
			[4]40,520								
14128910	Columbia River at Warrendale,	1990	196,000	93	106	52,500	31,500	68,500	6.5	2.0	10.0
	Oregon (streamflow station at	1975-89	155,300	82	128	45,100	22,800	77,300	6.5	0.5	10.5
	The Dalles, Oregon)	(Extreme yr)		(1975)	(1984)		(1978)	(1980)			
			[4]87,500								

[1]Dissolved -solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.
[2]To convert °C to °F: [(1.8 x °C) + 32] = °F.
[3]Mean for 6-year period (1983-89).
[4]Median of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING DECEMBER 1990

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1985 (cubic feet per second)	December 1990: Monthly mean discharge (cubic feet per second)	December 1990: Percent of median monthly discharge 1951–80	December 1990: Change in discharge from previous month (percent)	December 1990: Discharge near end of month: Cubic feet per second	December 1990: Discharge near end of month: Million gallons per day	December 1990: Discharge near end of month: Date
01014000	St. John River below Fish River at Fort Kent, Maine ...	5,665	9,758	11,140	227	–14	10,500	6,790	31
01318500	Hudson River at Hadley, New York........................	1,664	2,908	5,290	213	2	6,500	4,200	31
01357500	Mohawk River at Cohoes, New York	3,456	5,683	10,000	166	8	8,000	5,200	31
01463500	Delaware River at Trenton, New Jersey....................	6,780	11,670	21,060	181	46	24,700	16,000	31
01570500	Susquehanna River at Harrisburg, Pennsylvania..........	24,100	34,340	65,020	191	45	130,000	84,000	25
01646500	Potomac River near Washington, District of Columbia...	11,560	[1]11,500	[1]15,400	154	94	......	......	...
02105500	Cape Fear River at William O. Huske Lock, near Tarheel, North Carolina.	4,852	5,002	4,225	109	96	......	......	...
02131000	Pee Dee River at Peedee, South Carolina..................	8,830	9,871	11,100	148	–30	15,100	9,760	31
02226000	Altamaha River at Doctortown, Georgia...................	13,600	13,730	5,497	69	–18	6,450	4,170	31
02320500	Suwannee River at Branford, Florida......................	7,880	6,986	1,599	50	–4	......	......	...
02358000	Apalachicola River at Chattahoochee, Florida	17,200	22,420	8,789	52	4	......	......	...
02467000	Tombigbee River at Demopolis lock and dam, near Coatopa, Alabama.	15,385	23,520	41,600	204	1,230	141,000	91,100	31
02489500	Pearl River near Bogalusa, Louisiana......................	6,573	9,880	5,702	104	124	15,900	10,300	31
03049500	Allegheny River at Natrona, Pennsylvania.................	11,410	[1]19,580	[1]36,530	139	67	58,000	37,500	26
03085000	Monongahela River at Braddock, Pennsylvania...........	7,337	[1]12,480	[1]25,160	170	231	41,000	26,500	26
03193000	Kanawha River at Kanawha Falls, West Virginia.........	8,367	12,550	18,020	131	118	70,400	45,500	31
03234500	Scioto River at Higby, Ohio	5,131	4,583	17,240	426	470	38,200	24,700	31
03294500	Ohio River at Louisville, Kentucky[2]*......................	91,170	115,800	305,400	236	185	428,000	277,000	29
03377500	Wabash River at Mount Carmel, Illinois	28,635	27,660	60,590	264	202	105,000	67,900	31
03469000	French Broad River below Douglas Dam, Tennessee[3]*..	4,543	[1]6,739	[1]7,184	110	108	......	......	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wisconsin.[2]	6,010	4,238	3,408	95	–8	3,660	2,370	31
04264331	St. Lawrence River at Cornwall, Ontario, near Massena, New York.[4]*	298,800	243,900	252,000	105	–2	240,000	155,000	31
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	24,910	22,000	165	1	25,200	16,300	28
05082500	Red River of the North at Grand Forks, North Dakota...	30,100	2,593	222	19	–30	175	113	31
05133500	Rainy River at Manitou Rapids, Minnesota................	19,400	12,920	6,700	68	49	7,400	4,780	27
05330000	Minnesota River near Jordan, Minnesota..................	16,200	3,680	454	70	–37	285	184	31
05331000	Mississippi River at St. Paul, Minnesota*	36,800	[1]11,020	3,564	73	–42	3,260	2,110	31
05365500	Chippewa River at Chippewa Falls, Wisconsin	5,650	5,149	2,400	76	–40	3,120	2,020	31
05407000	Wisconsin River at Muscoda, Wisconsin	10,400	8,710	6,312	97	–14	5,400	3,490	31
05446500	Rock River near Joslin, Illinois.............................	9,549	6,080	6,310	135	26	5,000	3,200	31
05474500	Mississippi River at Keokuk, Iowa*.........................	119,000	63,790	39,130	107	–12	34,500	22,300	31
06214500	Yellowstone River at Billings, Montana....................	11,795	7,056	2,271	75	–32	2,100	1,360	18
06934500	Missouri River at Hermann, Missouri*.....................	524,200	80,880	30,960	76	5	51,600	33,400	31
07289000	Mississippi River at Vicksburg, Mississippi[5]*	1,140,500	584,000	618,400	125	71	1,220,000	790,000	31
07331000	Washita River near Dickson, Oklahoma....................	7,202	1,402	650	181	–28	921	595	31
08276500	Rio Grande below Taos Junction Bridge, near Taos, New Mexico.	9,730	742	464	109	–21	460	297	31
09315000	Green River at Green River, Utah..........................	44,850	6,391	1,443	60	–30	......	......	...
11425500	Sacramento River at Verona, California....................	21,251	19,430	10,590	51	39	......	......	...
13269000	Snake River at Weiser, Idaho................................	69,200	18,520	10,700	69	–9	10,900	7,040	31
13317000	Salmon River at White Bird, Idaho	13,550	11,390	3,210	69	–23	2,800	1,810	31
13342500	Clearwater River at Spalding, Idaho........................	9,570	15,510	6,550	103	–36	3,720	2,400	31
14105700	Columbia River at The Dalles, Oregon[6]*	237,000	[1]193,500	[1]99,340	114	–30	212,000	137,000	31
14191000	Willamette River at Salem, Oregon.........................	7,280	[1]23,690	[1]27,760	64	–1	14,300	9,240	31
15515500	Tanana River at Nenana, Alaska............................	25,600	23,810	7,974	118	–23	7,400	4,780	31
08MF005	Fraser River at Hope, British Columbia....................	83,800	96,250	43,430	99	–39	28,100	18,100	31

[1]Adjusted.

*Indicates stations excluded from the combination bar/line graph. See Explanation of Data.

[2]Records furnished by Corps of Engineers.

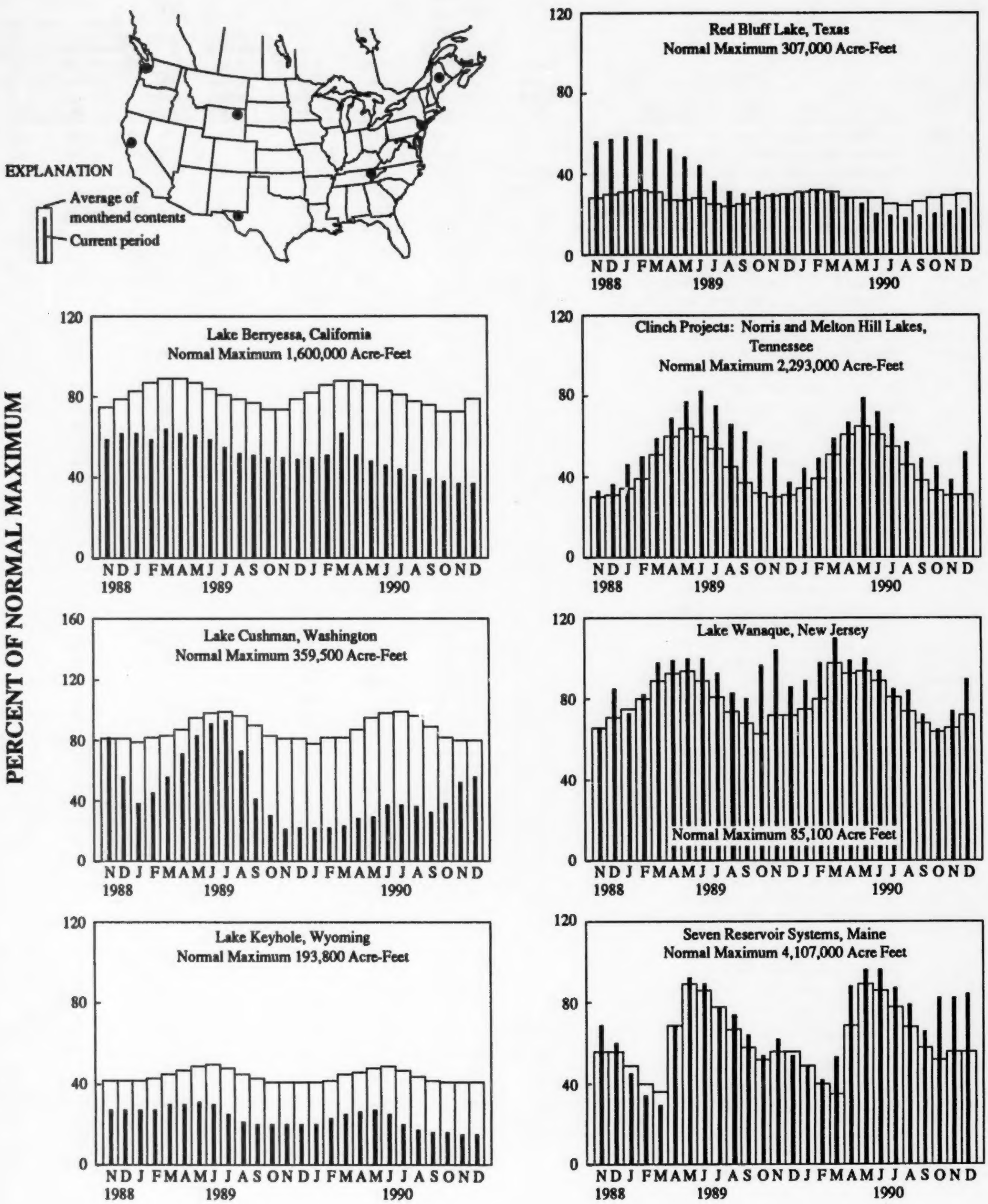
[3]Records furnished by Tennessee Valley Authority.

[4]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y., when adjusted for storage in Lake St. Lawrence.

[5]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[6]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS



USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF DECEMBER 1990

[Contents are expressed in percent of reservoir (system) capacity. The usable storage capacity of each reservoir (system) is shown in the column headed "Normal maximum"]

Reservoir Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Percent of normal maximum: End of December 1990	End of December 1989	Average for end of December	End of November 1990	Normal maximum (acre-feet)[1]
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	62	45	50	42	[2]226,300
QUEBEC					
Allard (P)	32	71	58	32	280,600
Gouin (P)	86	57	66	81	6,954,000
MAINE					
Seven Reservoir Systems (MP)	84	54	56	82	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	77	51	58	78	76,450
Lake Francis (FPR)	93	67	69	67	99,310
Lake Winnipesaukee (PR)	88	63	61	83	165,700
VERMONT					
Harriman (P)	77	58	60	68	116,200
Somerset (P)	79	75	68	77	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	91	84	72	85	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	80	55	52	76	786,700
Indian Lake (FMP)	78	59	61	81	103,300
New York City Reservoir System (MW)	92	84	77	85	1,680,000
NEW JERSEY					
Wanaque (M)	90	86	72	74	85,100
PENNSYLVANIA					
Allegheny (FPR)	39	24	33	36	1,180,000
Pymatuning (FMR)	91	82	81	88	188,000
Raystown Lake (FR)	67	60	57	67	761,900
Lake Wallenpaupack (PR)	72	54	57	74	157,800
MARYLAND					
Baltimore Municipal System (M)	94	88	83	93	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	95	91	78	91	288,800
Narrows (Badin Lake) (P)	94	90	93	95	128,900
High Rock Lake (P)	80	79	60	55	234,800
SOUTH CAROLINA					
Lake Murray (P)	66	85	62	61	1,614,000
Lakes Marion and Moultrie (P)	61	76	61	67	1,862,000
SOUTH CAROLINA-GEORGIA					
Strom Thurmond Lake (FP)	55	68	52	58	1,730,000
GEORGIA					
Burton (PR)	83	82	55	95	104,000
Sinclair (MPR)	86	89	76	87	214,000
Lake Sidney Lanier (FMPR)	42	64	50	41	1,686,000
ALABAMA					
Lake Martin (P)	73	73	61	87	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	52	37	31	38	2,293,000
Douglas Lake (FPR)	20	15	10	21	1,395,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	54	51	39	51	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	52	41	33	46	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	41	22	38	24	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	81	73	63	88	365,000
Wisconsin River (21 Reservoirs) (PR)	78	36	54	85	399,000
MINNESOTA					
Mississippi River Headwater System (FMR)	28	29	23	27	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	57	60	82	60	22,700,000
SOUTH DAKOTA					
Angostura (I)	42	42	69	41	130,770
Belle Fourche (I)	24	22	44	20	185,200
Lake Francis Case (FIP)	57	60	59	54	4,589,000
Lake Oahe (FIP)	55	57	64	55	22,240,000
Lake Sharpe (FIP)	103	101	98	100	1,697,000
Lewis and Clark Lake (FIP)	95	100	100	97	432,000
NEBRASKA					
Lake McConaughy (IP)	52	63	71	51	1,948,000
OKLAHOMA					
Eufaula (FPR)	96	97	88	96	2,378,000
Keystone (FPR)	81	84	92	80	661,000
Tenkiller Ferry (FPR)	103	103	95	102	628,200
Lake Altus (FIMR)	58	67	49	60	133,000
Lake O'The Cherokees (FPR)	92	87	81	89	1,492,000
OKLAHOMA-TEXAS					
Lake Texoma (FMPRW)	95	89	90	96	2,722,000
TEXAS					
Bridgeport (IMW)	85	88	48	89	386,400
Canyon (FMR)	94	84	79	95	385,600
International Amistad (FIMPW)	94	81	85	96	3,497,000
International Falcon (FIMPW)	78	49	77	77	2,668,000
Livingston (IMW)	101	97	88	101	1,788,000
Possum Kingdom (IMPRW)	91	86	95	93	570,200
Red Bluff (P)	22	30	30	21	307,000
Toledo Bend (P)	87	80	83	84	4,472,000
Twin Buttes (FIM)	49	48	34	48	177,800
Lake Kemp (IMW)	91	93	84	92	268,000
Lake Meredith (FMW)	32	39	37	33	796,900
Lake Travis (FIMPRW)	91	63	79	92	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	77	75	84	83	2,043,000
Fort Peck (FPR)	56	60	82	57	18,910,000
Hungry Horse (FIPR)	82	73	75	83	3,451,000
WASHINGTON					
Ross (PR)	83	81	69	92	1,052,000
Franklin D. Roosevelt Lake (IP)	87	95	92	101	5,022,000
Lake Chelan (PR)	88	61	55	97	676,100
Lake Cushman (PR)	56	22	80	52	359,500
Lake Merwin (P)	97	101	96	98	245,600
IDAHO					
Boise River (4 Reservoirs) (FIP)	36	42	55	34	1,235,000
Coeur d'Alene Lake (P)	48	47	54	128	238,500
Pend Oreille Lake (FP)	37	25	47	37	1,561,000
IDAHO-WYOMING					
Upper Snake River (8 Reservoirs) (MP)	46	58	59	36	4,401,000
WYOMING					
Boysen (FIP)	73	77	75	75	802,000
Buffalo Bill (IP)	38	52	66	39	421,300
Keyhole (F)	15	20	41	15	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	32	36	48	32	3,056,000
COLORADO					
John Martin (FIR)	9	11	18	7	364,400
Taylor Park (IR)	73	69	55	75	106,200
Colorado-Big Thompson Project (I)	47	36	57	48	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	66	75	72	67	31,620,000
UTAH-IDAHO					
Bear Lake (IPR)	33	50	58	33	1,421,000
CALIFORNIA					
Folsom (FIP)	15	33	54	17	1,000,000
Hetch Hetchy (MP)	19	43	37	27	360,400
Isabella (FIR)	8	15	26	8	568,100
Pine Flat (FI)	4	6	47	3	1,001,000
Clair Engle Lake (Lewiston) (P)	39	51	73	39	2,438,000
Lake Almanor (P)	65	66	50	67	1,036,000
Lake Berryessa (FIMW)	37	49	79	37	1,600,000
Millerton Lake (FI)	34	32	54	31	503,200
Shasta Lake (FIPR)	37	46	68	38	4,377,000
CALIFORNIA-NEVADA					
Lake Tahoe (IPR)	0	0	46	0	744,600
NEVADA					
Rye Patch (I)	0	6	50	0	194,300
ARIZONA-NEVADA					
Lake Mead and Lake Mohave (FIMP)	76	82	71	76	27,970,000
ARIZONA					
San Carlos (IP)	6	6	23	5	935,100
Salt and Verde River System (IMPR)	39	48	42	39	2,019,100
NEW MEXICO					
Conchas (FIR)	59	66	82	58	315,700
Elephant Butte and Caballo (FIPR)	63	72	41	59	2,233,300

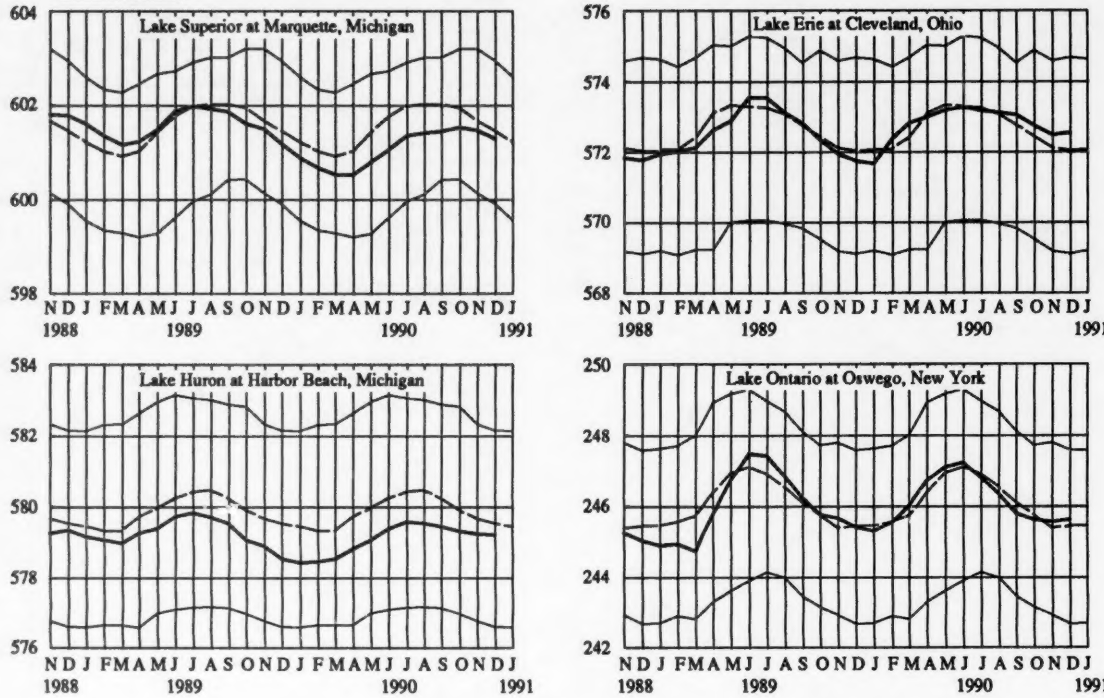
[1]1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second per day.

[2]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

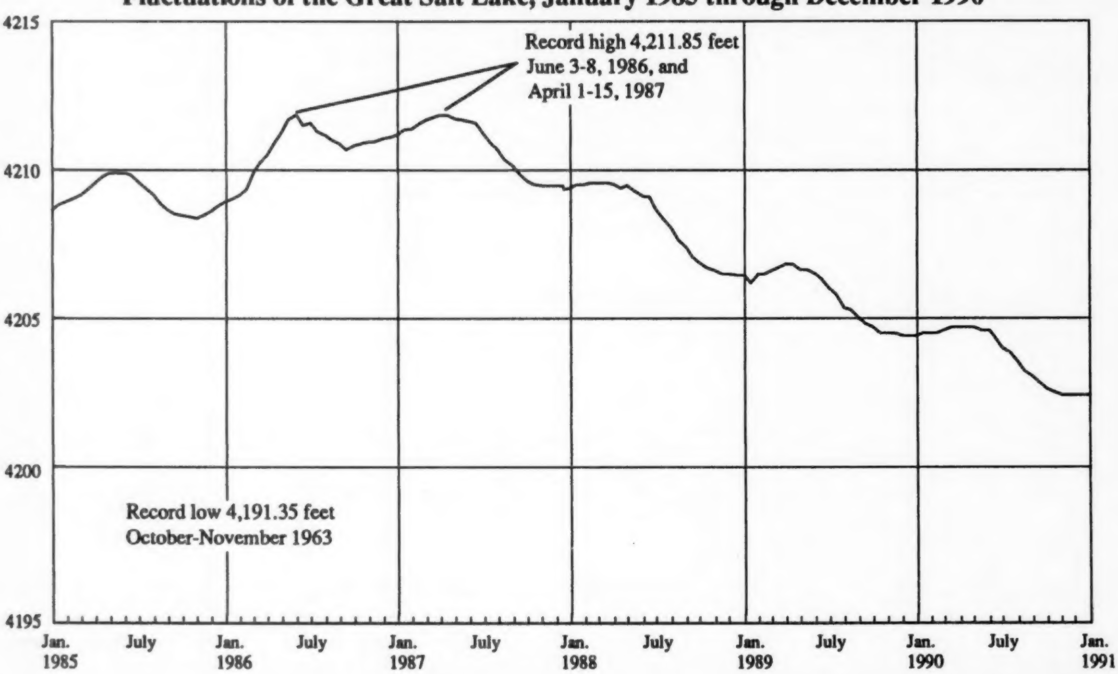
GREAT LAKES ELEVATIONS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.

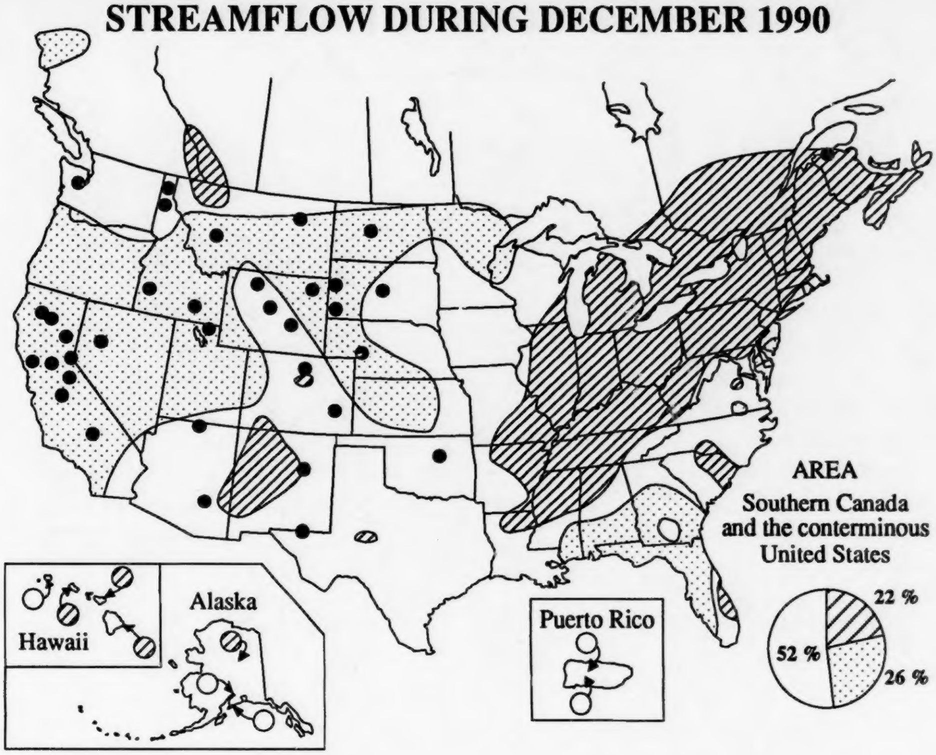
ELEVATION, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929



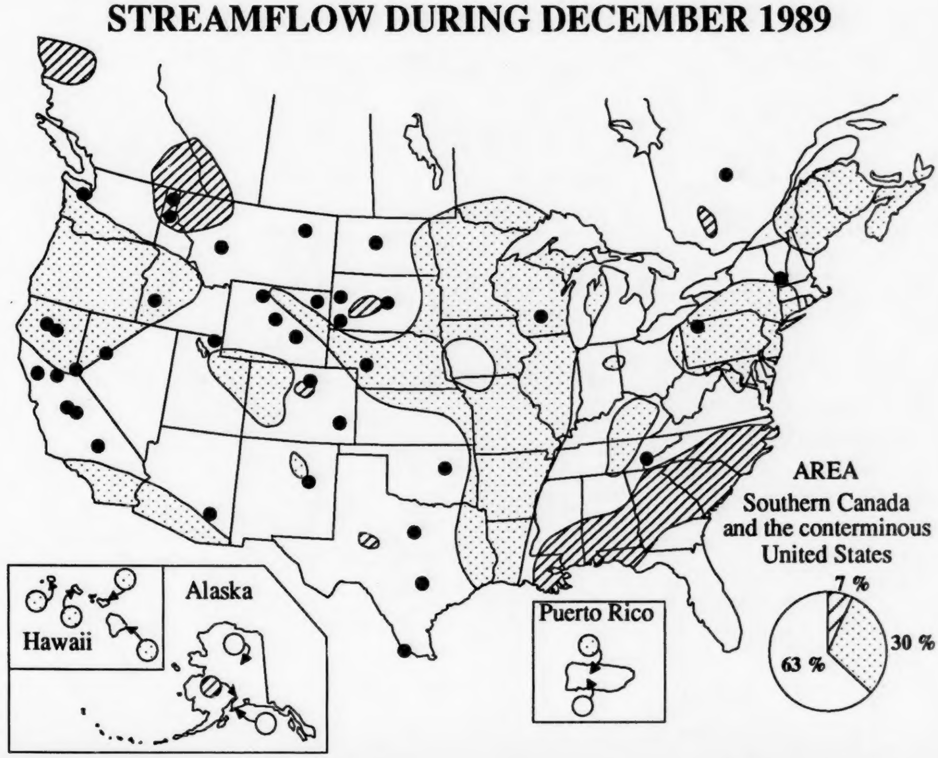
Fluctuations of the Great Salt Lake, January 1985 through December 1990



STREAMFLOW DURING DECEMBER 1990



STREAMFLOW DURING DECEMBER 1989



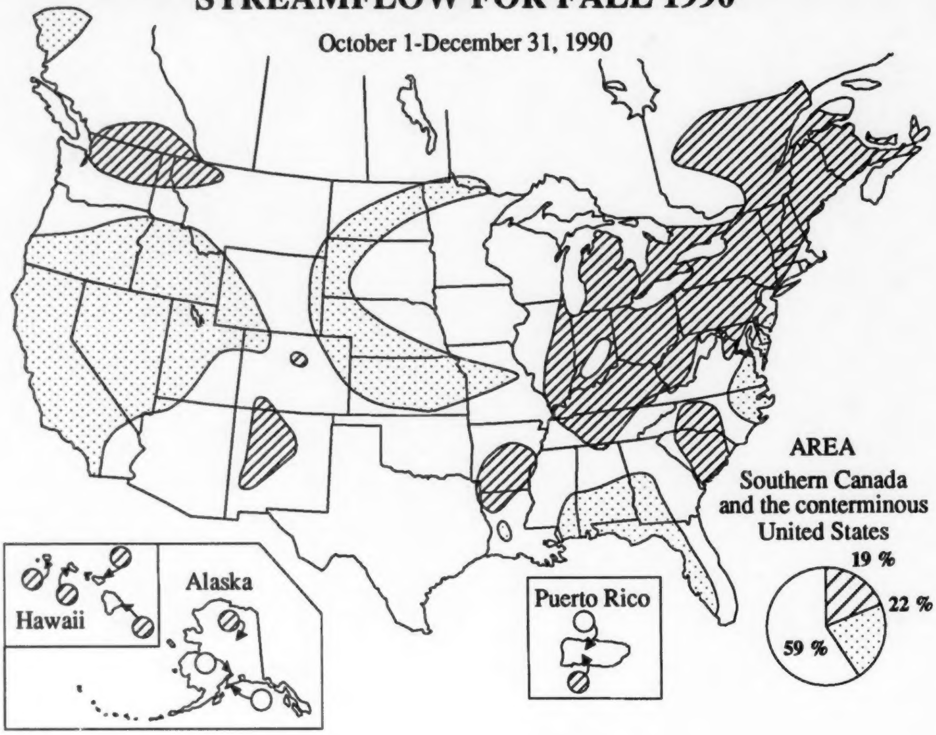
Above-normal range

Below-normal range

Below-average reservoir storage

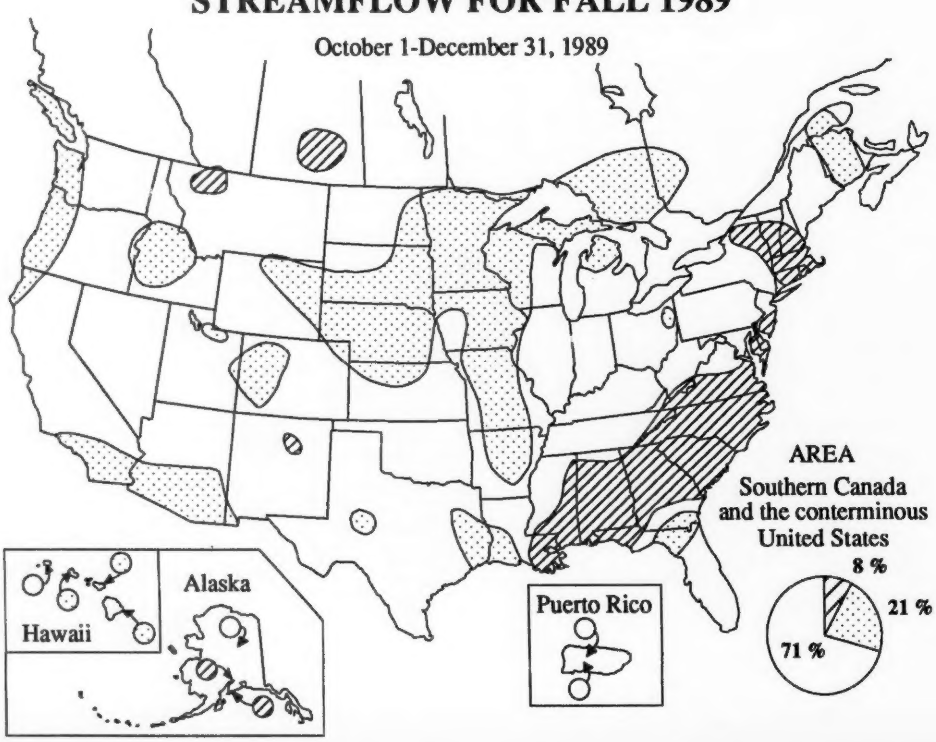
STREAMFLOW FOR FALL 1990

October 1-December 31, 1990



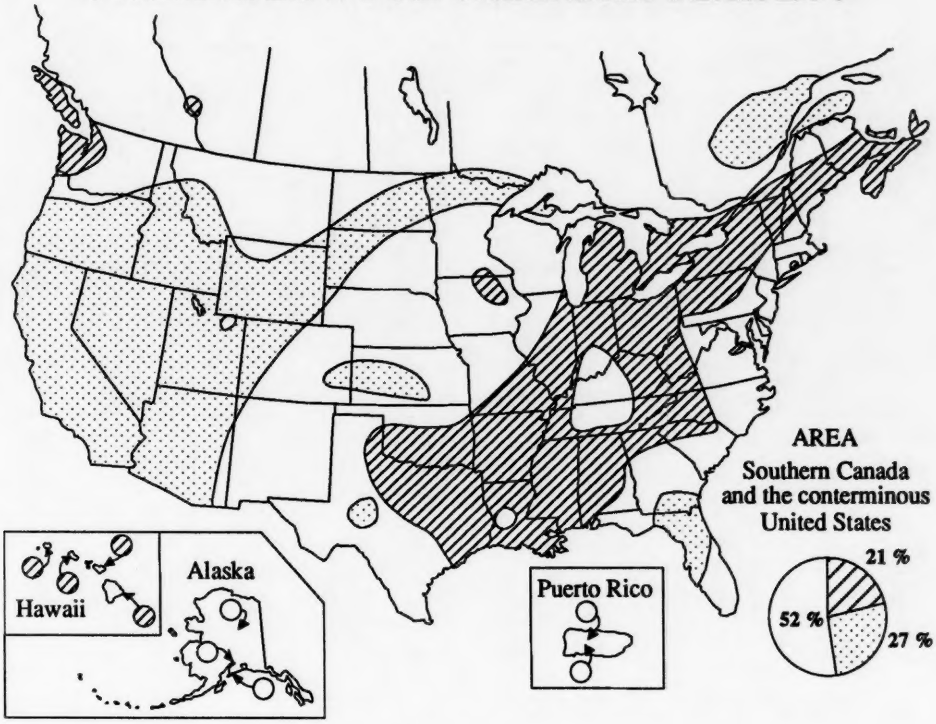
STREAMFLOW FOR FALL 1989

October 1-December 31, 1989

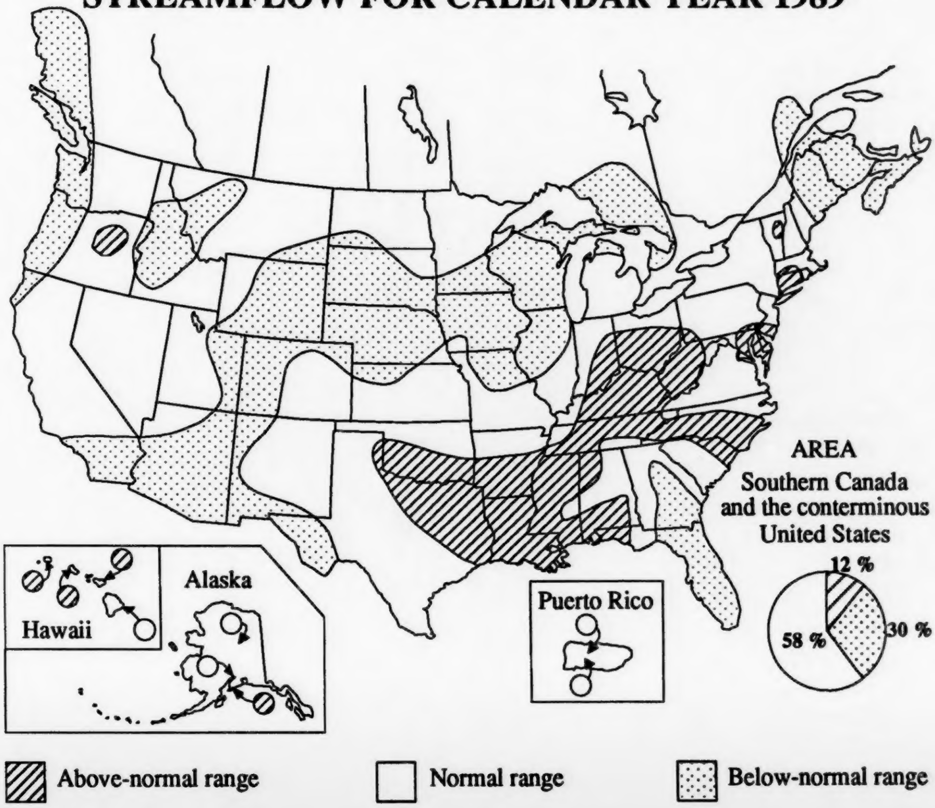


Above-normal range   Normal range   Below-normal range

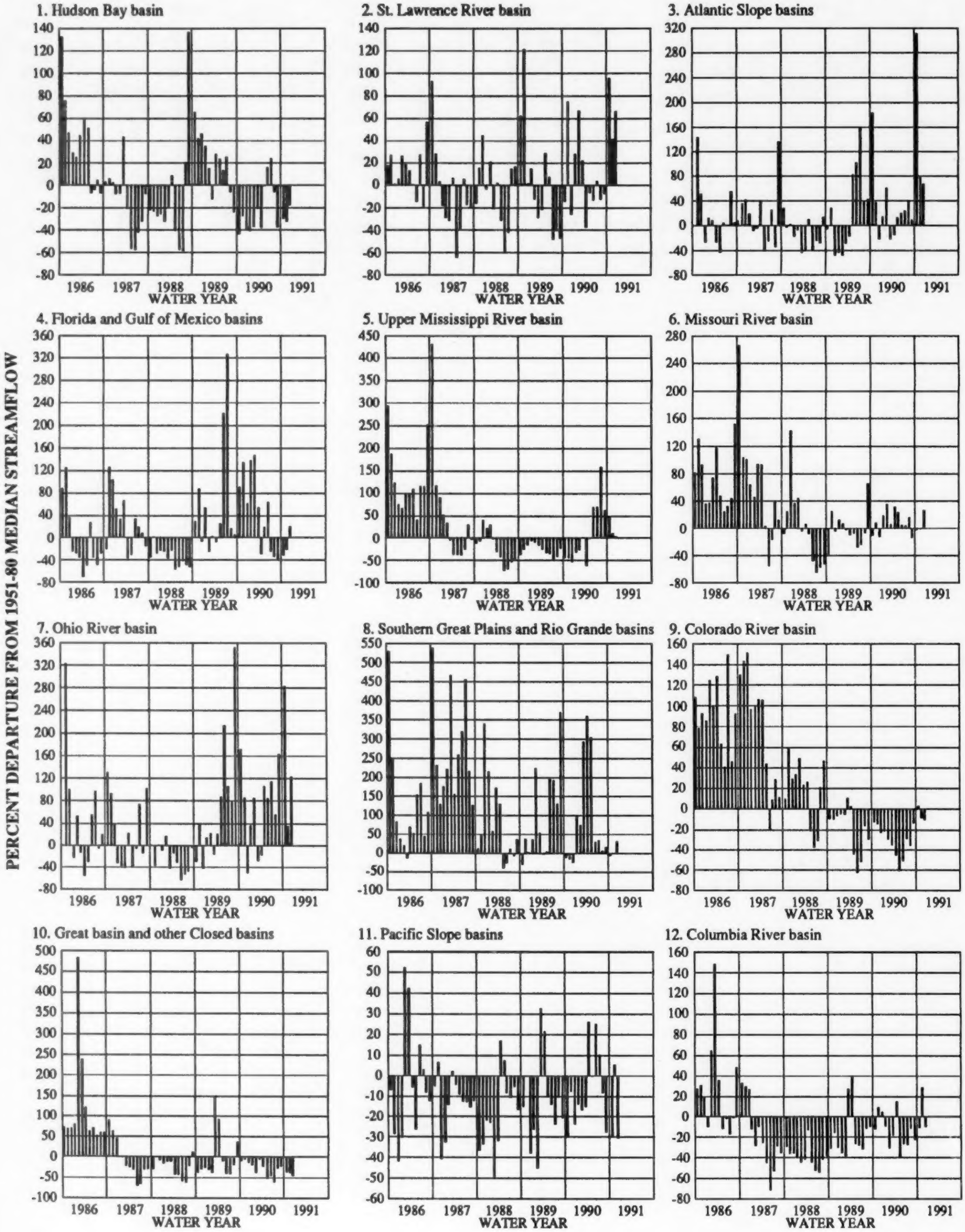
STREAMFLOW FOR CALENDAR YEAR 1990



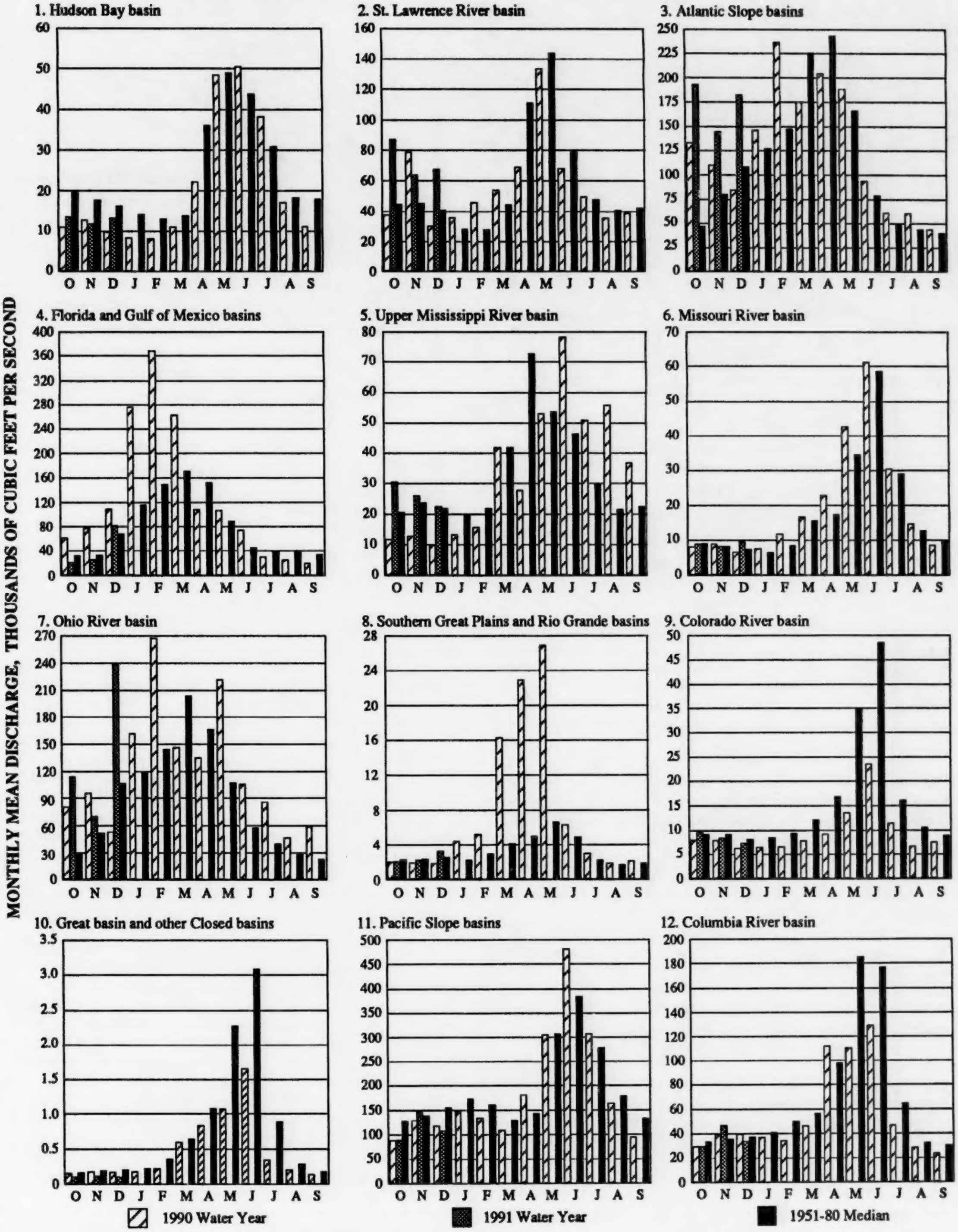
STREAMFLOW FOR CALENDAR YEAR 1989



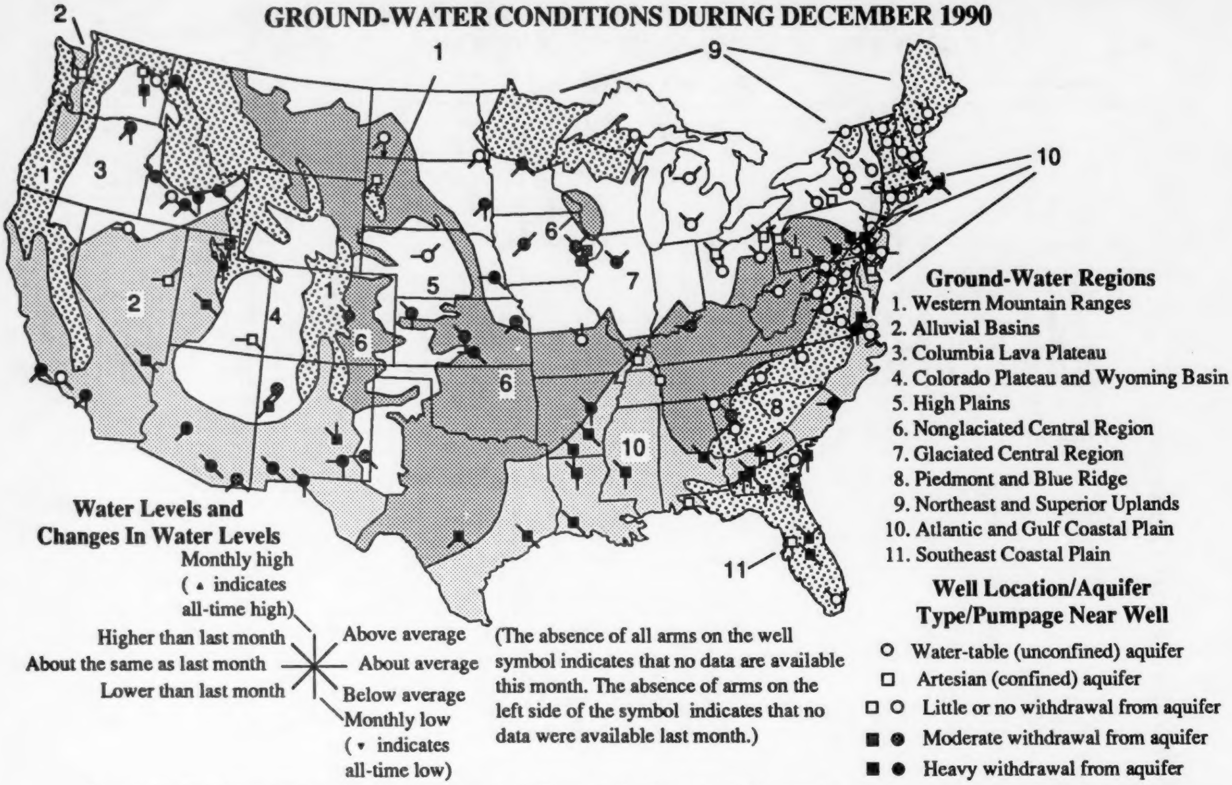
MONTHLY DEPARTURE OF ACTUAL STREAMFLOW (OCTOBER 1985-DECEMBER 1990) FROM MEDIAN STREAMFLOW (1951-80)



ACTUAL MONTHLY STREAMFLOW, 1990 AND 1991 WATER YEARS, COMPARED WITH MEDIAN MONTHLY STREAMFLOW, 1951-80



GROUND-WATER CONDITIONS DURING DECEMBER 1990



In southwest Florida, water levels are at all-time low levels at 10 percent of over 300 wells monitoring five aquifers in the area. Below average rainfall for the last three years, coupled with increased urban development and agricultural water use, has contributed to declining ground-water levels.

Ground-water levels in the two wells for the Western Mountain Ranges moved in opposite directions from last month to above average level in Washington and below average level in Idaho.

In the Alluvial Basins, levels rose above last month's levels except in California and parts of Arizona where they fell. Nevertheless, levels remained below average in most of the Region. December lows occurred in wells in the: Alluvial sand and gravel aquifer at Baldwin Park, California (see table); Basin fill aquifers at Holladay (12 years of record), and Logan (51 years of record), Utah; Roswell Basin shallow aquifer at Dayton, New Mexico (40 years of record); and Hueco bolson aquifer at El Paso, Texas (see table). Level rose to a new December high in the Roswell Basin artesian aquifer well at Roswell, New Mexico (25 years of record).

Levels in the Columbia Lava Plateau were mixed with respect to last month, but remained below long-term averages. Despite a rise in level since last month, a December low occurred in the Snake River Plain aquifer well at Rupert, Idaho (41 years of record). December lows also occurred in wells in: the Columbia River Basalts aquifer at Pendleton, Oregon (see table); Grand Ronde Basalt aquifer at Odessa (20 years of record), and the sand aquifer interbedded in the Grand Ronde Basalt at Mansfield (17 years of record), Washington.

In the Colorado Plateau and Wyoming Basin, water levels remained the same or were below last month's levels. Levels remained below average in Utah and above average in New Mexico.

In the High Plains Region, levels generally remained the same as last month's: below long-term averages, except in Nebraska where they were above average. Despite a rise in level since last month, a December low occurred in the Ogallala aquifer well at the Agricultural Experiment Station at Colby, Kansas (see graph).

Levels in the Non-glaciated Central Region fell from last month in the Dakotas and parts of Texas and Pennsylvania. Elsewhere, levels rose or remained the same. Levels were below long-term averages in the Dakotas, Kansas, and parts of Texas and Pennsylvania; and above average elsewhere. December highs occurred in the Ozark aquifer well at Rolla, Missouri (3 years of record), and in the Clarion Formation well in Westmoreland County, Pennsylvania (23 years of record). Monthly lows occurred in the: Minnelusa aquifer well near Tilford, South Dakota (7 years of record); Equus Beds aquifer well at Halstead, Kansas (51 years of record), and Stonehenge Formation well at Greencastle, Pennsylvania (16 years of record). An all-time low occurred in the Sentinel Butte aquifer well at Dickinson, North Dakota (see table).

In the Glaciated Central Region, levels were below last month's, and also below long-term averages in the Dakotas and Kansas, mixed with respect to both last month's levels and average in Iowa and mixed with respect to last month's levels and below average in Wisconsin. Level at the well in Nebraska remained the same as last month and remains below average. Elsewhere levels were above both last month's levels and average. December lows occurred in the Big Sioux aquifer well at Bell Rapids, South Dakota (13 years of record), and in the Cambrian-Ordovician aquifer at Mount Vernon, Iowa (4 years of record). December highs occurred in the Glacial drift aquifers in Reese (45 years of record), and Dover (31 years of record), Ohio.

Water levels were generally the same or above last month's in the Piedmont and Blue Ridge: below long-term averages in Georgia and part of Virginia, elsewhere above average. Level rose to a December high in the Weathered granite aquifer well at Mocksville, North Carolina (see table). A December low occurred in the Surficial saprolite aquifer at Griffin, Georgia (see table).

In the Northeast and Superior Uplands, levels fell in Minnesota, Wisconsin, Michigan, and part of Vermont, and remained the same or rose elsewhere with respect to last month. Levels were below long-term averages in Minnesota and Michigan, average in Wisconsin, and above average elsewhere. December highs occurred in the Glacial till aquifer well at Augusta, Maine (see table); and the Stratified drift aquifer at Warner, New Hampshire (26 years of record).

In the Atlantic and Gulf Coastal Plain, levels declined from last month or remained the same in Maryland, Virginia, Georgia, Florida, and parts of New Jersey, and rose elsewhere. Levels were generally at or below average, except in Georgia where they were mixed, and in Delaware and Kentucky where they were above average. December lows occurred in the Middle Potomac aquifer well at Franklin (31 years of record) and in the Upper Potomac aquifer well at Toano (6 years of record), Virginia ; Pee Dee aquifer well at Collins Park, South

Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES–DECEMBER 1990

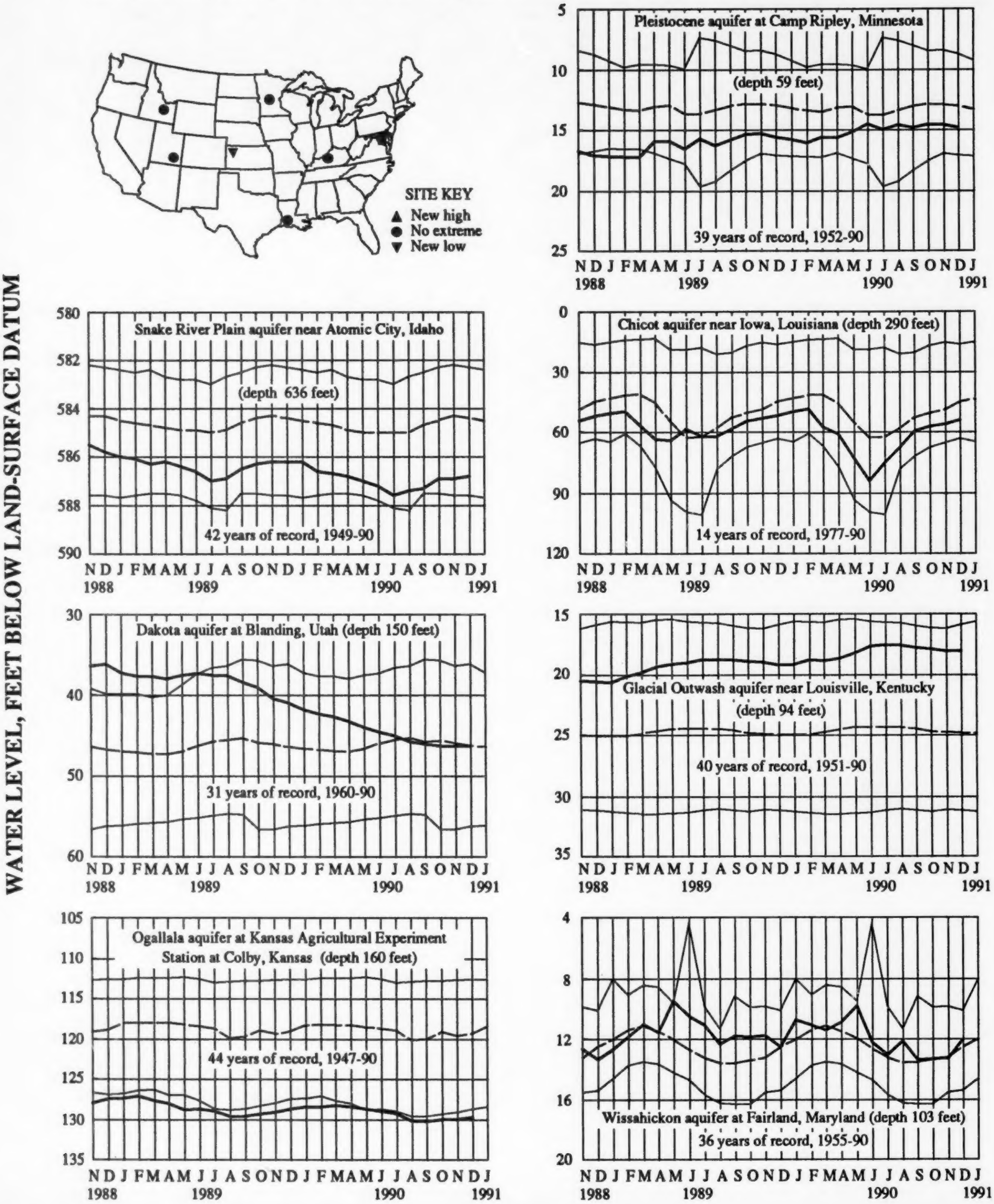
GROUND–WATER REGION Aquifer and Location	Aquifer type and local aquifer pumpage	Depth of well in feet	Water level in feet below land–surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Last year	Year records began	Remarks
WESTERN MOUNTAIN RANGES (1)								
Rathdrum Prairie aquifer, Athol, northern Idaho	●	480	462.2	–0.5	–2.6	4.9	1929	
ALLUVIAL BASINS (2)								
Alluvial valley fill aquifer in Steptoe Valley, Nevada	□	122	8.28	4.03	.10	–.87	1950	
Alluvial sand and gravel aquifer, Baldwin Park, California	●	200	186.57	–65.46	–.51	–8.22	1932	Dec. low
Valley fill aquifer, Elfrida area, Douglas, Arizona	◍	124	100.86	–18.52	–1.17	–1.39	1951	
Hueco bolson aquifer, El Paso area, Texas	●	640	270.90	–20.81	.95	–.94	1965	Dec. low
COLUMBIA LAVA PLATEAU (3)								
Snake River Plain aquifer, at Eden, Idaho	●	208	123.8	–5.8	–2.1	–.7	1957	
Columbia River Basalt aquifer, Pendleton, Oregon	◍	1,501	218.55	–27.53	–.15	–3.65	1965	Dec. low
COLORADO PLATEAU AND WYOMING BASIN (4)								
Dakota aquifer, Blanding, Utah	□	140	46.38	–.48	–.04	–5.45	1960	
HIGH PLAINS (5)								
Wind–blown sand deposits of the High Plains Aquifer System, Dunning, Nebraska	○	13	3.68	.23	.03	.35	1934	
Southern High Plains aquifer, Lovington, New Mexico	◍	212	59.83	–4.23	.06	–.07	1971	
NON–GLACIATED CENTRAL REGION (6)								
Sentinel Butte aquifer, Dickinson, North Dakota	○	160	21.11	–2.50	–.11	–1.24	1968	All–time low
Sand and gravel Pleistocene aquifer, Valley Center, Kansas	●	54	20.10	–2.70	–.03	–.82	1937	
Glacial outwash sand and gravel aquifer, Louisville, Kentucky	◍	94	18.01	6.83	.06	1.24	1945	
Upper Pennsylvanian aquifer in the Central Applachian Plateau, Glenville, West Virginia	○	25	15.47	1.25	.10	–.70	1954	
GLACIATED CENTRAL REGION (7)								
Fluvial sand and gravel aquifer, Platte River Valley, Ashland, Nebraska	●	12	7.56	–1.40	.10	–.68	1933	
Sheyenne Delta aquifer, Wyndmere, North Dakota	○	40	8.80	–2.69	–.12	–.20	1963	
Pleistocene (glacial drift) aquifer, at Princeton in northern Illinois	◍	29	6.02	6.30	.58	1.63	1942	
Shallow drift aquifer at Roscommon in north–central part of Lower Peninsula, Michigan.	○	14	4.52	.30	.09	1.17	1934	
Silurian–Devonian carbonate aquifer near Dola, Ohio	□	51	6.14	3.05	.70	2.69	1954	
PIEDMONT AND BLUE RIDGE (8)								
Water–table aquifer in Petersburg Granite, southeastern Piedmont, Colonial Heights, Virginia.	○	100	16.31	–.33	–.07	–1.51	1939	
Weathered granite aquifer, western Piedmont, Mocksville area, North Carolina.	○	31	15.62	4.81	.41	.21	1981	Dec. high
Surficial aquifer at Griffin, Georgia	○	30	21.39	–4.43	–.05	–4.01	1943	Dec. low
NORTHEAST AND SUPERIOR UPLANDS (9)								
Pleistocene glacial outwash aquifer, Camp Ripley, Minnesota	◍	59	14.85	–1.8	–.21	.73	1949	
Glacial till aquifer at Augusta, Maine	○	22	4.04	1.65	.66	2.31	1960	Dec. high
Shallow sand aquifer (glacial deposits), Acton, Massachusetts	●	34	18.88	.44	.11	–.46	1965	
Pleistocene sand aquifer, Morrisville, Vermont	○	50	17.44	1.23	.31	1.84	1966	
ATLANTIC AND GULF COASTAL PLAIN (10)								
Columbia deposits aquifer, Camden, Delaware	□	11	8.29	1.38	.71	–2.67	1950	
500–foot sand aquifer near Memphis, Tennessee	■	384	107.62	–16.76	.22	–.70	1940	Dec. low
Eutaw aquifer in the City of Montgomery, Alabama	■	270	26.5	–4.3	.6	–1.1	1952	
Evangeline aquifer, Houston area, Texas	■	1,152	311.89	–9.29	1.94	–14.04	1978	
SOUTHEAST COASTAL PLAIN (11)								
Upper Floridan aquifer on Cockspur Island, Savannah area, Georgia	■	348	37.26	–9.61	.84	–1.03	1956	Dec. low
Upper Floridan aquifer, Jacksonville, Florida	■	905	–19.8	–8.8	.2	–.4	1930	Dec. low
Biscayne aquifer, Homestead, Florida	○	20	7.93	.73	.86	.21	1932	

Carolina (17 years of record); Dublin aquifer well at Taversville, Georgia (16 years of record); Sparta Aquifer System well at Jackson, Mississippi (47 years of record); 500-foot sand aquifer well at Memphis, Tennessee (50 years of record); Sparta Sand aquifer well at El Dorado (37 years of record), and Mississippi Valley alluvial aquifer at Lonoke (23 years of record), Arkansas; and Sparta Sand aquifer well at Ruston, Louisiana (17 years of record). Level rose to a December high in the Claiborne aquifer well in Viola, Kentucky (40 years of record).

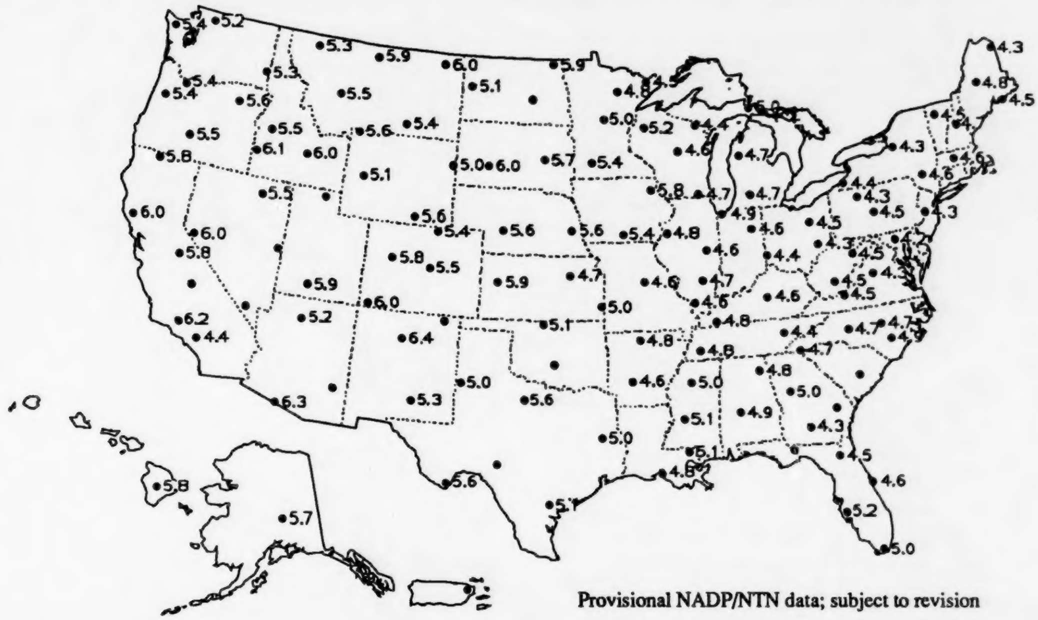
Levels were mixed with respect to last month's in the Southeastern Coastal Plain and were generally below long-term averages in Georgia and mixed with respect to average in Florida. December lows occurred in Upper Floridan aquifer wells at Valdosta (see table), Brunswick (28 years of record), Albany (28 years of record), and on Cockspur Island (35 years of record), Georgia; and also in Jacksonville (see table), and San Antonio (27 years of record), Florida. December lows also occurred in the Claiborne and Clayton aquifer wells in Albany, Georgia (13 and 34 years of record respectively).

MONTHEND GROUND-WATER LEVELS IN SELECTED WELLS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.



pH of Precipitation for November 26 - December 23, 1990

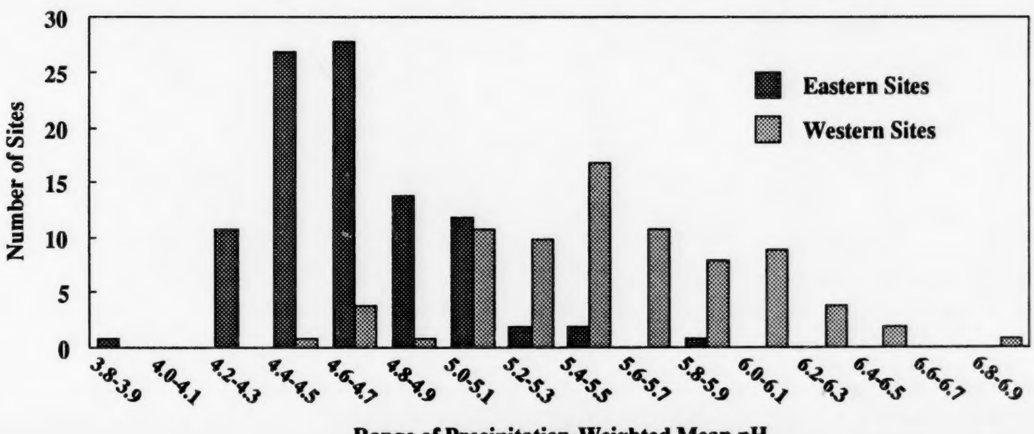


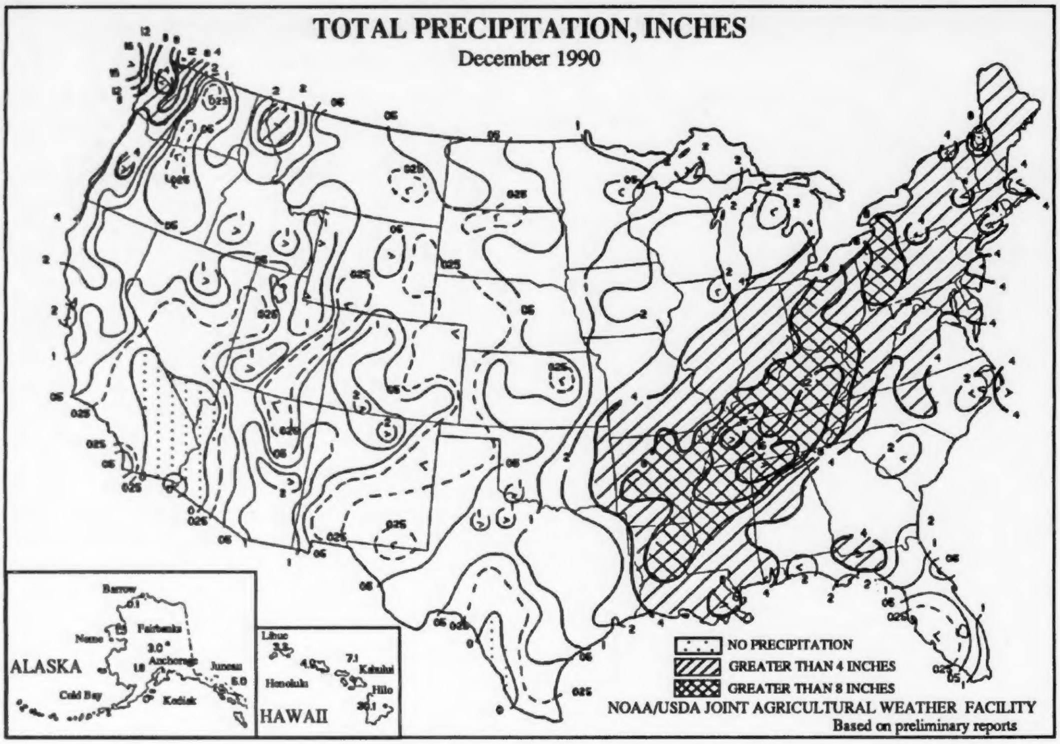
Provisional NADP/NTN data; subject to revision

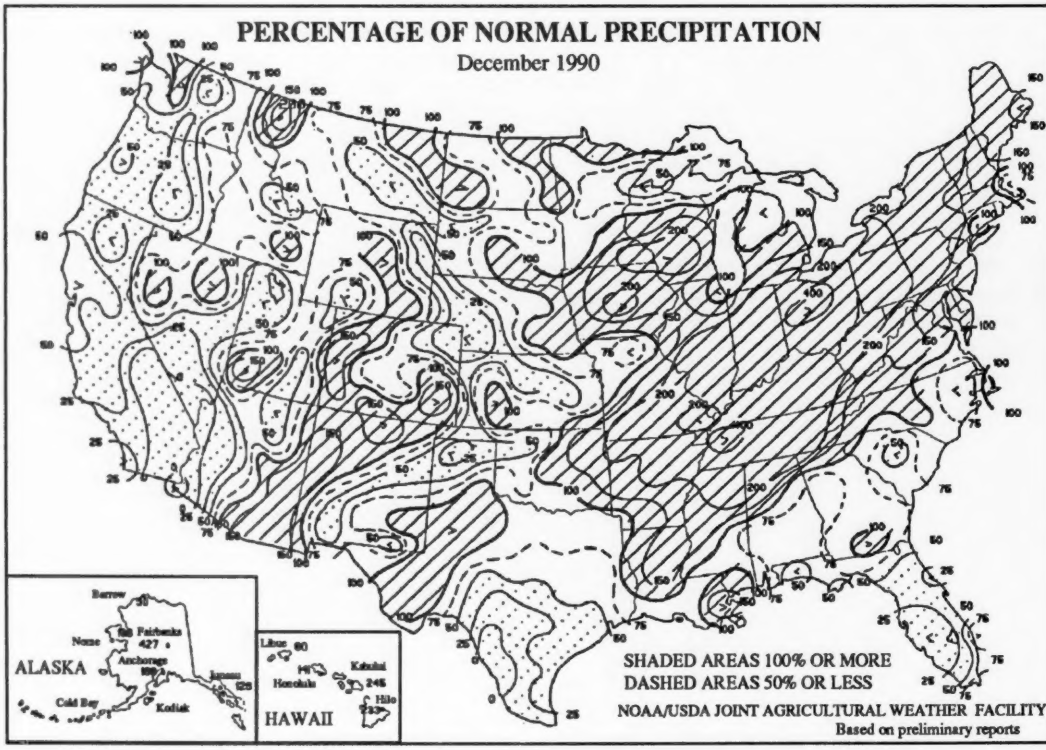
Current pH data shown on the map (• 4.9) are precipitation-weighted means calculated from preliminary laboratory results provided by the NADP/NTN Central Analytical Laboratory at the Illinois State Water Survey and are subject to change. The 127 points (•) shown on this map represent a subset of all sites chosen to provide relatively even geographic spacing. Absence of a pH value at a site indicates either that there was no precipitation or that data for the site did not meet preliminary screening criteria for this provisional report.

A list of the approximately 200 sites comprising the total Network and additional data for the sites are available from the NADP/NTN Coordination Office, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.

Distribution of precipitation-weighted mean pH for all NADP/NTN sites having one or more weekly samples for November 26 - December 23, 1990. The East/West dividing line is at the western borders of Minnesota, Iowa, Missouri, Arkansas, and Louisiana.





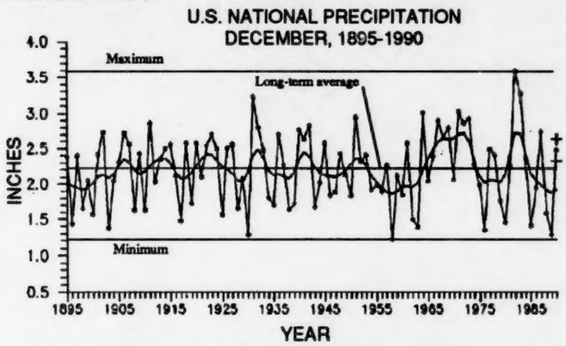


(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

UNITED STATES DECEMBER CLIMATE IN HISTORICAL PERSPECTIVE

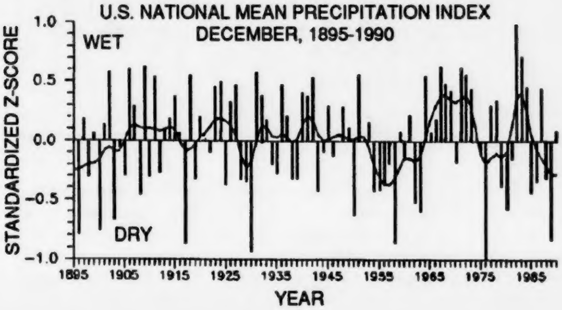
(From Climate Perspectives Branch, Global Climate Lab, NCDC, NOAA)

Preliminary data for December 1990 indicate that temperature averaged across the contiguous United States was much below the long-term mean. December 1990 ranked as the eighteenth coldest December on record (the record begins in 1895). The 1990 value is based on preliminary data, which has been shown to be within 0.25 °F of the final data over a 22-month period. While December 1990 was not as cold nationally as December 1989, Decembers during the last 30 years may be returning to a colder regime similar to the early 1900's, departing from the less extreme regime of the 1930's to 1950's.



Areally-averaged precipitation for the nation was slightly above the long-term mean (graph above), ranking December 1990 as the 34th wettest (63rd driest) December on record. The preliminary value for precipitation is estimated to be accurate to within 0.16 inches and the confidence interval is plotted in the graph above as a '+'.

Historical precipitation is shown in a different way in the graph below. The December precipitation for each climate division in the contiguous U.S. was first standardized using the gamma distribution over the 1951-80 period. These gamma-standardized values were then weighted by area and averaged to determine a national standardized precipitation value. Negative values are dry, positive are wetter than the mean. This index gives a more accurate indication of how precipitation across the country compares to the local normal climate. The areally-weighted mean standardized national precipitation ranks December 1990 as the 46th wettest December on record. The filtered curves in both graphs suggest that the United States has fallen into a period of generally drier-than-normal Decembers, similar to the mid-1950's to early 1960's.

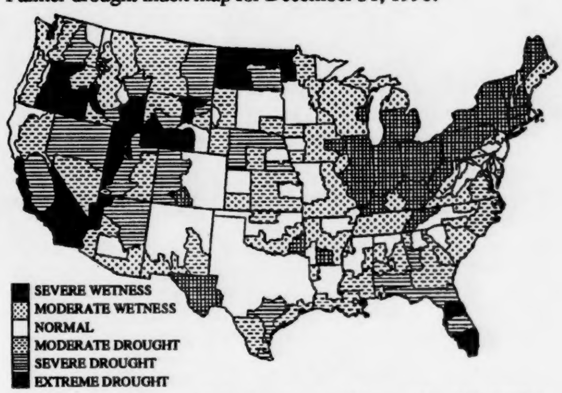


About half (52.9%) of the country had December precipitation wetter than the normal in 1990, while half (47.1%) was drier than normal.

About a third (31.6%) of the contiguous U.S. was warmer than normal and two-thirds (68.4%) was cooler than normal. Large temperature extremes occurred at both ends of the scale, with about 13 percent of the country much warmer than normal but 41 percent much colder than normal. This resulted in an unusually cold nationwide temperature index for December 1990.

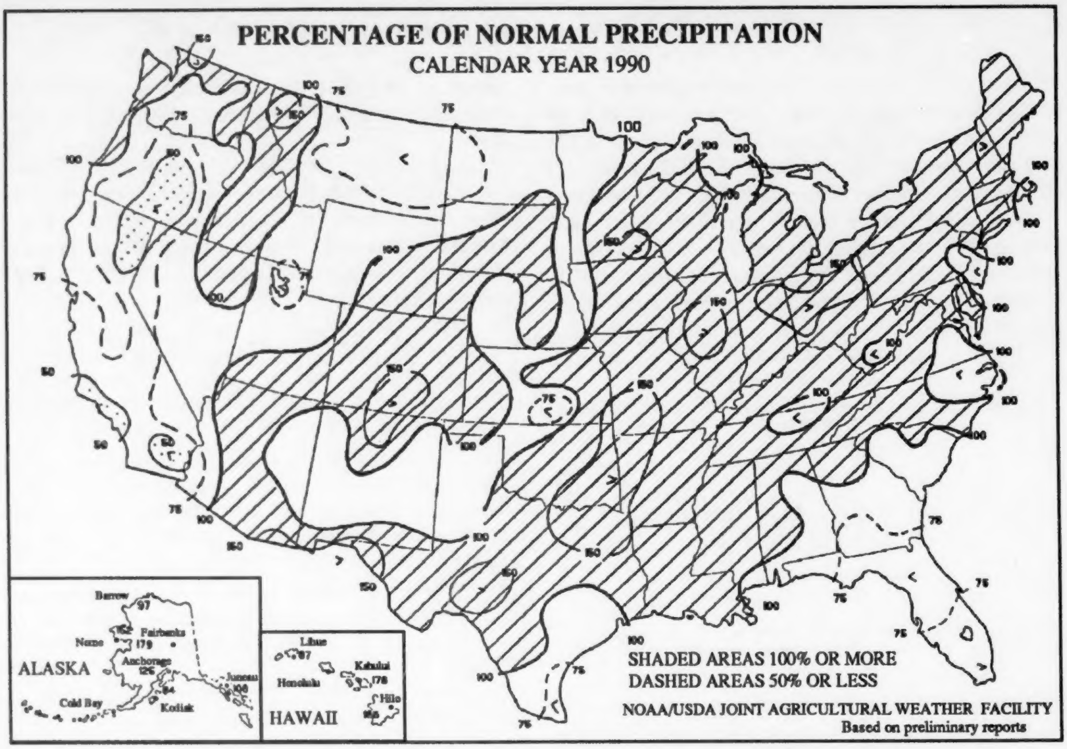
In general, temperatures were warmer than normal east of the Mississippi River and colder than normal to the west. The West and Northwest regions had the coldest December on record and the Southwest had the fifth coldest December, while the Northeast ranked fifth warmest (92nd coldest) and the Southeast ranked ninth warmest (88th coldest). According to National Weather Service records, over 260 daily record low temperatures and over 160 daily record high temperatures were reported during the month. Precipitation was concentrated mainly along the Ohio River valley to New England (see maps on previous page), with the Central region having the wettest December on record and the Northeast region the fifth wettest December. The month was on the dry side of the historical distribution for the Southeast, West, and Northwest regions.

The percent of the contiguous United States experiencing severe to extreme long-term wet conditions rose to about 14 percent during December 1990, while approximately a fourth continued severely to extremely dry. Fourteen other Decembers have had a larger drought area than December 1990. The severe drought areas stretched from the West to the northern plains, and included parts of the Gulf Coast, while the severely wet areas were concentrated mainly in the Ohio valley and the Northeast, as shown below on the Palmer drought index map for December 31, 1990.



Growing season precipitation for the Primary Hard Red Winter Wheat belt (extending roughly from Nebraska to the Texas panhandle) was below normal this year, with October-December 1990 ranking as the 37th driest such period on record. This marks the fourth consecutive year with sub-normal precipitation during the first three months of the growing season and stands in sharp contrast to the extremely wet conditions of the mid-1980's.

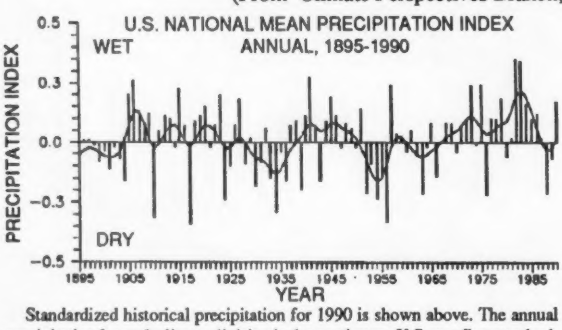
According to preliminary data from the National Weather Service, there were 53 tornadoes across the United States in December 1990, which is well above the 1953-1989 average of 19.2 but is not a record.

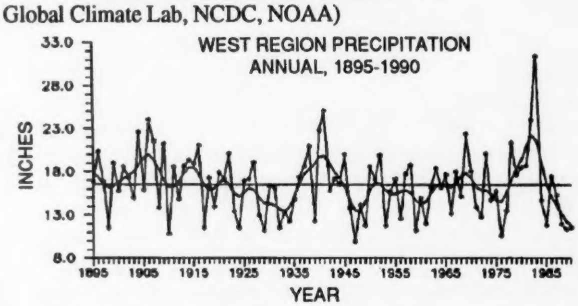


(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

UNITED STATES ANNUAL CLIMATE IN HISTORICAL PERSPECTIVE

(From Climate Perspectives Branch, Global Climate Lab, NCDC, NOAA)

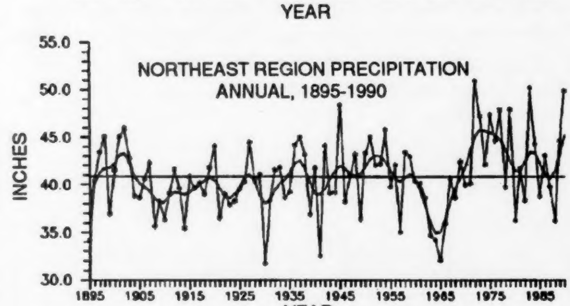




Standardized historical precipitation for 1990 is shown above. The annual precipitation for each climate division in the contiguous U.S. was first standardized using the gamma distribution over the 1951-80 period. These gamma-standardized values were then weighted by area and averaged to determine a national standardized precipitation value. Negative values are dry, positive are wetter than the mean. This index gives a more accurate indication of how precipitation across the country compares to the local normal climate. The areally-weighted mean standardized national precipitation ranks 1990 as the 14th wettest year on record.

The annual precipitation rankings for 1990 for the nine climatically homogeneous regions in the United States indicate that in general, annual precipitation ranked driest in a band from the California coast to the northern Plains, and in the Southeast region. The West region had the tenth driest year on record in 1990, which is the fourth consecutive year of below-normal precipitation. (See first graph below.) With six of the last seven years being drier than normal, the filtered curve has reached record low levels.

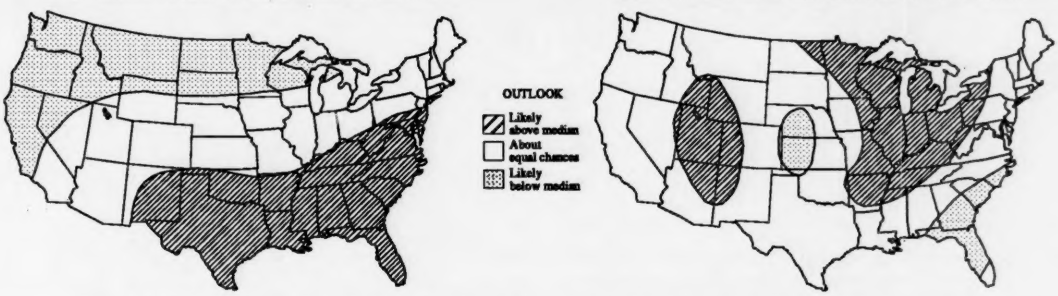
In 1990 the Northeast saw a return to the unusual wetness that characterized much of the last two decades, which itself contrasted sharply with the persistent dryness of the 1960's. (See second graph below.)



Two states (California and Florida) had rankings in the driest ten category, and three states (Illinois, Indiana, and Ohio), 1990 had the wettest year on record.

Annual ranking for precipitation in the 18 major river basins shows that 1990 ranked as the wettest year on record in the Great Lakes basin and second wettest in the Upper Mississippi and Ohio river basins. The California river basin ranked sixth driest.

TEMPERATURE OUTLOOK FOR JANUARY-MARCH 1991 PRECIPITATION OUTLOOK FOR JANUARY-MARCH 1991



From *Monthly and Seasonal Weather Outlook* prepared and published by the National Weather Service

NATIONAL WATER CONDITIONS

DECEMBER 1990

Based on reports from the Canadian and U.S. Field offices; completed January 28, 1991

TECHNICAL STAFF

Thomas G. Ross, Editor
Judy D. Fretwell
Krishnaveni V. Sarma

COPY PREPARATION

Thomas G. Ross
Kristina L. Herzog
Krishnaveni V. Sarma
Bernard A. Malo

GRAPHICS

Thomas G. Ross
Krishnaveni V. Sarma
Kristina L. Herzog
Judy D. Fretwell

The National Water Conditions is published monthly. Subscriptions are free on application to the U.S. Geological Survey, 419 National Center, Reston, VA 22092.

EXPLANATION OF DATA (Revised December 1990)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 186 index gaging stations—18 in Canada, 166 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951-80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, and the Puerto Rico index stations because of the limited records available.

The ***streamflow ranges map*** shows where streamflow has persisted in the above- or below-normal range from last month to this month and also where streamflow is in the above- or below-normal range this month after being in a different range last month. Three ***pie charts*** show: the percent of stations reporting discharges in each flow range for both the conterminous United States and southern Canada, and also the percent of area in each flow range for the conterminous United States and southern Canada. The ***combination bar/line graph*** shows the percent departure of the total mean from the total median flow (1951-80) and the cumulative departure from median (in cfs) for all reporting stations (excluding eight large river stations indicated by * in the ***Flow of large rivers*** table) in the conterminous United States and southern Canada.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude—the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range), 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as: in the ***above-normal range*** if it is greater than the upper quartile, in the ***normal range*** if it is between the upper and lower quartiles, and in the ***below-normal range*** if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as ***seasonal*** if the change is in the same direction as the change in the median. If the change is in the opposite direction of the change in the median, the change is classified as ***contraseasonal*** (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. ***Probability of occurrence*** is the chance that a given flood magnitude will be exceeded in any one year. ***Recurrence interval*** is the reciprocal of probability of occurrence and is the average number of years between occurrences. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. ***Recurrence intervals imply no regularity of occurrence***; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about ***ground-water levels*** refer to conditions near the end of the month. The water level in each observation well is compared with average level for the end of the month determined from the entire period of record for that well. ***Changes in ground-water levels***, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). ***Dissolved solids*** are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. ***Dissolved-solids discharge*** represents the total daily amount of dissolved minerals carried by the stream. ***Dissolved-solids concentrations*** are generally higher during periods of low streamflow, but the highest dissolved-solids discharges occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

☆ U.S. Government Printing Office : 1991 - 281-941/20011

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
NATIONAL CENTER, STOP 419
RESTON, VIRGINIA 22092

OFFICIAL BUSINESS

Return this sheet to above address, if you do NOT wish to receive this material ☐, or if change of address is needed ☐ (indicate change, including ZIP code).

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT 413

U.S. MAIL

FIRST CLASS

NWC 004486
SPECIAL PROCESSING DEPT
MARCIA KOZLOWSKI
XEROX/UNIVERSITY MICROFILMS
ANN ARBOR, MI 48106-9999